

Aviation Week & Space Technology

June 17, 1963

SPECIAL REPORT:

Advanced Rocket
Motor Studies

Nihon YS-11 Transport

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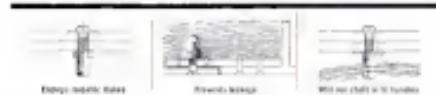
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AEROSPACE CALENDAR

June 26-27-10th Annual Symposium on Computer and Data Processing, University of Denver, Denver Research Institute, Elkhorn Ranch, Park City, Colo.

June 26-27—Symposium on Dynamics of the Atmosphere, University of Wyoming, Laramie, Wyo.

July 1-3—National Conference on Space Weather, Hotel New York, N.Y. Sponsored by Cornell Atmospheric Laboratory, Army Transportation Corp.

July 14-16—Second Annual Denver Fly-in, Denver Beach Hotel, Denver, Colo.

July 1-3—Conference on the Application of Survey Engineering, University of Illinois, Urbana, Ill.

July 3-13—National Conference on Atmospheric Education, National Atmospheric Sciences Division, Hanover, N.H.

July 19-21—Flood Conference, St. Paul, Minn.

July 29-31—International Symposium on Space Telecommunications, Institute of Electrical and Electronic Engineers Professional Group, Group on Antennas and Propagation, University of Illinois, Urbana, Ill.

July 31-August 4—Advanced Training and Operations Course, Army Institute of Acoustics and Acoustics and American Meteorological Society, Ft. Monmouth, Calif.

Aug. 1-2—National Final Fly-in, Broomfield, Calif. to Atlanta, Ga., N.Y.

Aug. 15-26—10th Annual International Conference, The Woods Hole Science Center, Woods Hole, Mass., Calif.

Aug. 21-23—Tropical Pacific Conference, Honolulu, Hawaii.

June 17, 1982
Vol. 70, No. 24

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For demonstrations contact: Atlantic Aviation, Wilmington, Del.; Pacific Airlines, Burbank, Calif.; Transair Aviation, Montreal, Canada.

AEROSPACE CALENDAR

[Continued from page 73]

Sept. 23-27—National Aerospace and Space Engineering and Manufacturing Meeting and Display Society of Automotive Engineers, Ambassador Hotel, Los Angeles

Sept. 23-25—AIAA/ASME/SAE/ASCE/ASME/AIAA Conference, Sheraton Plaza, London, Eng. 1st Sponsor: Institution of Electrical Engineers (London); American Institute of Aerodynamics and Aerodynamics, Institute of Electrical and Electronics Engineers, Society of Automotive Engineers

Sept. 23-26—National Aerospace and Space Engineering and Manufacturing Meeting and Display Society of Automotive Engineers, Chicago, Ill. Sponsor: Ross Research Development Center, Aviation Research Foundation

Sept. 26-Oct. 1—IAS Congress, International Aerospace Federation, Paris

Sept. 26-Oct. 3—Mobile Interplanetary Exploration Voyage, American Institute of Aerodynamics and Aerodynamics, Caliente Motor Hotel, Pala, Alta., Calif.

Sept. 28-Oct. 3—Cordless Electronics Conference, Institute of Electrical and Electronics Engineers, Radiation Park, Toronto, Canada

Oct. 13-Eighth National Symposium on Space Electronics, Institute of Electrical and Electronics Engineers, Fontainebleau Hotel, Morris Beach, N.Y.

Oct. 13—National Aerospace Nuclear Safety Testing Meeting, Institute of Nuclear Sciences, Albuquerque, N.M. Co-sponsors: Los Alamos Scientific Laboratory, AEC Aerospace Operations Office, M. S. Naval Weapons Center, AF Directorate of Nuclear Studies, Sandia Corp., University of New Mexico

Oct. 14—National Air Traffic Seminar, Sheraton-Oklahoma Hotel, Oklahoma City, Okla.

Oct. 15—North Atlantic Communications Symposium, Institute of Electrical and Electronics Engineers, Hotel Union, New York

Oct. 15-16—Aerospace Navigation and Telecommunications Conference, Aerospace Electric Society, Pan-Pacific Auditorium, Los Angeles, Calif.

Oct. 15-16—Annual Meeting and Convention, Airport Operators Council, Atlantic City, N.J.

Oct. 16-18—Aerospace Research and Testimony, Air Traffic Control, Army Safety Board Hotel, Dulles, Va.

Oct. 16-Ballistic Symposium on Ballistic Missile and Space Defense, Caltech, Naval Test Center, San Diego, Calif.

Oct. 16-17—Space Systems, AF Ballistic Systems Div., Aerospace Corp.

Oct. 16-17—Fourth National Vacuum Symposium, American Vacuum Society, Hotel Hilton Hotel, Boston, Mass.

Oct. 17-18—21st North American Conference on Aerodynamics and Aerodynamics-Crashworthiness and Space Institute Board of Aerospace Sciences, Massachusetts Institute of Technology, Cambridge, Mass.

Oct. 18-20—Tenth Annual East Coast Conference on Aerospace and Navigation Electronics, Institute of Electrical and Electronics Engineers, Roosevelt Hotel, Baltimore, Md.

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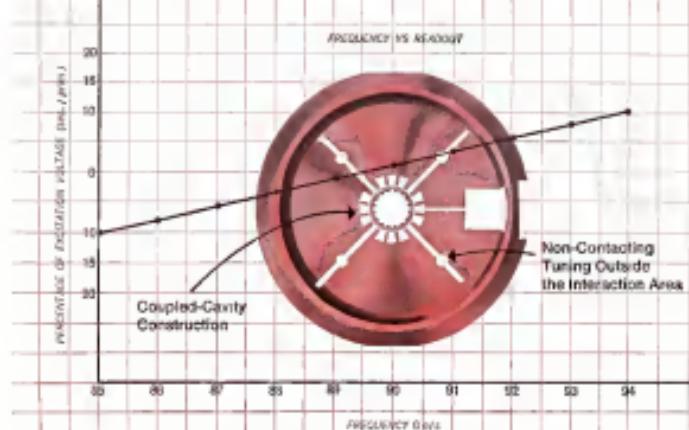
comes to those with whom he has been able to meet and to assess their needs. The Route connects reliability with a quality control program second to none. It has a highly capable management continuously throughout manufacture and application.

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第二章 会议管理与组织

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| Peak Anode Current | 27.5-Arms |
| Rate of Voltage Rise | 225 V/μsec |
| Peak Free Output | 3200 kWe |
| Pulse Width | 0.1-1.5-μsec |
| Pulse Cycle | 10/60s |
| Frequency Range | 3000-5400 Hz |
| Statistical Efficiency (Pulse) | 0.02% |
| Efficiency Factor | 10% |



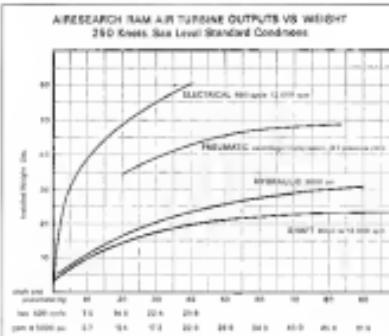
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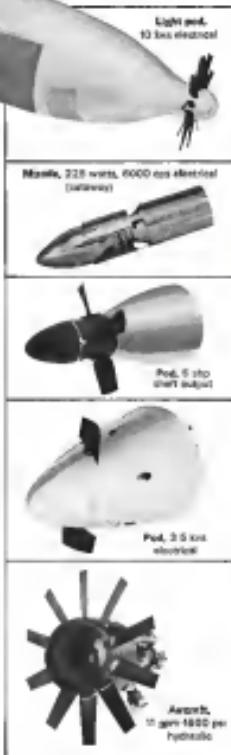
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alouette 3

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WORKS A PERKINS, INC.

Volume 78
Number 24

Aviation Week & Space Technology

CONTENTS

Figure 17, 1994-3

JOHN W. MURRAY
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EAST BUSINESS MANAGER
THE NEW YORK TIMES
PHOTOGRAPH BY MURRAY

ANNUAL REPORT OF THE SECRETARY OF STATE, June 12, 1943

proto-*Pravutya* of the *Nihon YS-11* turboprop short-haul transport is shown in flight during its Tokyo-Japan Cell Anchors Bureau certification in October, with the first delivery due next year. The 22.60-seat aircraft is powered by two Rolls-Royce "Trent" 701-1A12 turboprops. Although *Pravutya* has visited 20 plants, the Japanese Cell Anchors Agency has 100 VIP transport out of the Cell Anchors Bureau's 400.

France Leaps Into Space

merging man/machine/mission

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First in a series of OH-5A design analyses

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Last week at Le Bourget we saw France leap into space with a program aimed at establishing itself at the head of major forces in the development of space technology, no longer only by the United States and the Soviet Union. The French space program has been developing swiftly during the past 11 months. But the full scope and pace of this effort became evident to foreign observers only after a startling exhibit of French space technology at the 35th International Air and Space Show and a special presentation of the program's full details by top officials. George Peltre, cabinet minister for nuclear and space research, and Paul Goulois, director of the new French space research agency (CNES), headed this group.

Although the collection of exhibits at Le Bourget was, at worst, meager, it was the evidence of the major French drive into space that demonstrated that this drive—despite the changing of its name to include space along with aerospace—was a reality. French President Charles De Gaulle's intensive understanding that any nation hoping to survive in the modern world must develop its own capability amidst the extreme spectrum of key technologies (AW, June 10, p. 21). Evidence of just how important President De Gaulle regards aerospace technology is a foundation of modern France can at Le Bourget where he stretched a scheduled two-hour tour to the show into 2½ hours, including a 30-min. detailed inspection of the excellent NASA space exhibit. He said he spent with NASA specific questions on details of U.S. space projects displayed at the show. The personal interest is reinforced by his decision to fund space research areas which fall in the space technology spectrum, plus an operational program for us French scientists, or some have added key funds to French aeronautical programs to keep their expert resources rolling. These French moves in the aerospace field have been about exactly the same as those taken recently by the government of Gustav Bataillon, where a similar aerospace technology assessment has been allowed to deteriorate and has for little effort been forced to push back into these technologies: nuclear, electronics and space technology. We predict that these government decisions on the new technologies will have a major effect on the strategic roles of these countries in the leadership of Western Europe in the not-horizon future.

In an extremely converging character, the French national space program is organized basically after the U.S. pattern as regard its relation with the military, industry and scientific community and universities. Indeed, it has been greatly assisted by the U.S. through training of French engineers in satellite technology at NASA's Goddard Space Flight Center, and by providing the French Air Forces and Societé Nationale Industrie Aéronautique et spatiale (Sofinair) and the Paris Matche Bourgogne, during the interim before the French became fully operational. France also is involving the international scope of its space program under bilateral agreements with India and Argentina involving licenses and scientific cooperation. It appears certain that as the French space capability develops, its industry will become the source of hardware for many nations interested in their space station programs who prefer not to depend on the United States and cannot get help from the Soviet Union. Just as it did in well as developing its postwar aircraft industry from the ashes of World War 2, France is carefully planning its space program to avoid duplicating major efforts by the U.S. and Russia, such as manned space flight, and is concentrating on things gaps left by those programs.

The prime reason for the success achieved with postwar French aircraft as export markets was the unique character

of their products, which filled gaps left by U.S. and British aircraft and engines. The French space program, as now planned, appears to be aimed initially at developing basic knowledge and operational capability in satellite technology. Not until this capability is achieved do the French plan to branch out in new directions with contributions to space services based on Prof. J. E. Bissner's work with upper-atmosphere atomic hydrogen.

Meanwhile, the French industry, as it did a decade ago with supersonic aircraft technology, is working hard on developing a broad capability in the most modern techniques related to all areas of space technology. Many foreign observers at the French space pavilion were surprised to see more than a dozen additional aviation firms exhibiting space work ranging from pharmaceutical rocket cargo with surgical tools, medical guidance systems, plasma engines and many nuclear power sources to communications systems, advanced space instrumentation, environmental monitoring and lasers.

Although France is developing its own space program and the required industrial support under a law passed by Prof. Goulois, only it clear that France will continue to participate in and cooperate with the joint European space efforts now being organized through EELDO and ESSO. However, he was equally emphatic that France does not intend to be slowed by the pace of these organizations in development of its own capabilities. Whatever possible, French contributions to these joint efforts would be in building a complete program on data out within the framework of the EELDO objectives rather than just contributing segments to the overall program as is currently being done in the EELDO booster program. None of the top French space leaders appear to be undermining the importance of the technical, financial and political problems involved in starting the French space program. French industry is known to be good. For much of the technical knowledge it needs for its push into space, not as it faced the painful but necessary cost of violating fair production of supersonic aircraft at a time when most allied nations passed at this cost.

Putting the past a decade ago gave France the European leadership in the supersonic era of aviation. The French space effort appears to merit whatever cost may be necessary to lead Europe in the space age. A further indication of how the French are viewing their space effort as a long-term investment in the program organized under the direction of Gen. Robert Arnoux, technical director of CNES, to educate French technical students in construction and use of small space vehicles, while also providing facilities and encouragement for these well-motivated students. France obviously is relying on its best engineers to carry the load in its space exploration.

At Le Bourget the large static display of the U.S. space exhibit stands next to the long, thin skeletoons of France's first space booster—the Thoracane-Diamant—coating an effort, as Prof. Goulois noted, of an Oriental mosquito. The United States' exhibit was truly impressive for its technical maturity and breadth of effort if it deserved as proof of progress advanced as in aital space exhibit two years ago. The French exhibit reflects the youthful stage of enthusiasm and determination that characterized the U.S. exhibit two years ago. In comparing the two it is easy to see how much can be accomplished when inspiring sport and political support can merge. Hopefully, the French-American space museum at Le Bourget will remain as a symbol of the extraordinary achievements that are possible as expanding man's horizons when strong national capabilities are blended in making the best of technical cooperation.

—Robert Hines



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WHO'S WHERE

In the Front Office

Thomas Nest, president and chief exec
for officer, Reliance Technical Project
Inc., Teaneck, N. J., and C. S. Johnson,
lead engineer, G. D. F. S. Laboratories, Inc.,
and chairman and chief executive officer
has returned his resignation as a director.

He is a former member of the board of directors of the American Society of Appraisers and is a member of the Appraisers Association of America. He is a member of the Appraisers Association of America and the Appraisers Association of America.

Walter Brown Jr., vice president and general manager of the Engineering Div., appointed acting general manager of the newly activated Advanced Planning Div., San Bernardino (Calif.) Operations of Aerospace Corp., and William M. Bonneau, group director, Weapons Systems Div., a newly established group in the Advanced Planning Div.

Solney L. Spiegel, vice president marketing, Liberty Electronics Corp., Englewood, Colo., a subsidiary of Wyle Laboratories; Harrison F. Edwards, executive vice president, Standard Products Inc., Teterboro, N.J.

E. A. Christoff, vice president-exploiting, Glam Corp. See Gabriel, Chil., and Thomas V. Tucker, contributor.

Edo de Bento Brazil. T. C. Ryback succeeds Mr. Hoy as president and general manager of Wright Machinery Co. Inc. of Springfield, Mass., Woburn, N. G.

Donald L. Pyle, research in the very pros-
pect for research and development, Thompson River Workshops Inc., Redondo Beach, Calif.

Dr Frank J. Malina (accepts the letter). Dr Theodor von Kármán is director of the International Academy of Astronautics until the academy's biannual meeting in September.

The Ministry of Aviation, U.K. has confirmed the appointment of Rear Adm. Sir Matthew Shattock as chairman of ADAC until July 25, 1964. Appointment extended until June 19, 1965. Sir Wilfrid Nokes, deputy chairman. Sir Walter Warburton, member. General P. G. F. Pease, member.

House and Elections

Edward E. Hartman, of General Dynamics/Aerospace, has received the Air Force Systems Command Award for his "contribution to the deterrent strength and mobility of the United States and the free world" as manager of the space navigation section in the Atlas F and E series.

INDUSTRY OBSERVER

Long-term investigation of methods weapons which would not intense, high-energy light bursts generated by optical lasers is not progressing satisfactorily. Although the feasibility of using optical lasers in lethal weapons has not yet been demonstrated for some time, output levels of lasers now being developed under the Advanced Research Projects Agency programs are below levels targeted for this date.

Effects of nuclear anti-personnel weapons on ships and aircraft that launch these weapons are being measured at the Naval Ordnance Laboratory, Silver Spring, Md. Up to two tons of conventional explosives are being used. Scientists extrapolated from data gathered from the tests will provide a foundation of knowledge in developing means of protecting the ships and aircraft.

USAF's Relocate Systems Div. will evaluate solutions concepts for an advanced KC135R deployed in underwing positions for crewmember and warfighter. These concepts will extend beyond the industry studies which AF Force already is supporting. Navy also is preparing a similar weapon deployment in an in-house study of advanced standard detainees for the 9730 (AFW Aug. 1, p. 23).

Acacoyer organizations experting in combat flight in Aerospace Systems Development and the search of contracts with Advanced Development Objective (ADO) 12 to investigate a new, high performance tactical fighter (AM May 21, p. 21), include Republic Aviation, Nasvh, North American Aviation, Lockheed, Boeing and a team of Ross Aerospace and Northrop.

Special summer study group will convene at the Navy War College, Newport, R. I., on June 24 for a month-long analysis of signal processing techniques used in sonar, sonobuoy and other fields which might be adapted to improve the submarine detection capability of Navy's active and passive sonars. Approximately 10-15 scientists will participate in the program, recruited by the Institute of Defense Analysts under sponsorship of the Navy's Bureau of Ships and Office of Naval Research.

Competitions to select a contractor for development of a stellar inertial Doppler system (SIDS) for possible use in a wide variety of Air Force aircraft are being conducted by USAF's Astronautical Systems Div.

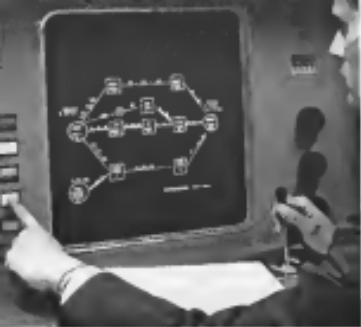
Difficulties experienced in coupling power into electrical propulsion engines in the delayed NASA's space electric rocket test (SERT) program, for which the United Corp. of America is building test rockets to be launched by Boeing Contractors (IAW Sept 4, 1961, p 34) Rosemont, Lower Research Center was the original proposal prepared for SERT 2 in 1960 as the present power converter problem is not unique. SERT 2 is planned as an orbital flight test of a 3-kw, solar cell powered ion source (IAW Dec. 3, p 1970).

At Estate Systems Command it is expected to initiate soon an industry competition for an advanced guidance system for possible application to the T-33 space booster. This would extend beyond the present 45-month development program which involves 17 vehicles using an A. C. Sparkling developed T-33 guidance system.

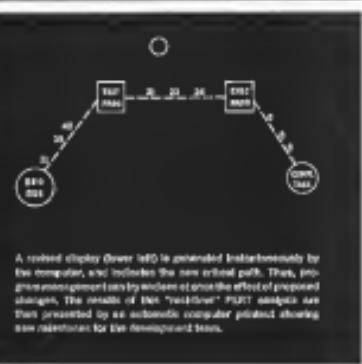
Effect of Air Force participation in NASA's Centaur program will be limited to a single experiment on each of 12 spacecraft. Defense Dept is not to participate as a partner unless it obtains a voice in the management of the program commensurate with the money it would be required to put

USAF's Aerospace Systems Div. is evaluating proposals for development of a manufacturing process for switchable positive-negative ionizers for use in a certain ion-propelled system. Aim will be to obtain material of uniform size and high structural stability under high-temperature conditions.

NASA expects to award a study contract this month for a broad study of a peripheralized lunar base. As a follow-on, NASA will sponsor a series of programs for studying base subsystems, such as nuclear powerplants, life support systems and lunar surface transportation systems.



The PERT operator (top left) reviews the desired-line critical path on the COED MARK II display. He uses the joy stick to indicate with a small circle the activity or path to be revised. The new schedule estimate is inserted by push button control.



A revised display shown left is generated automatically by the computer, and indicates the new critical path. This improvement eliminates by redesign the most affected proposed design. The results of this "walkthrough" PERT analysis are then presented by an automatic computer printout showing new milestones for the development team.

COED MARK II, a second generation Computer Operated Electronic Display, applies the combined brain power of man and machine to the solution of space age problems. Other applications of the MARK II, in addition to PERT analysis, include real-time displays of helicopter flight control, lunar vehicle steering, missile guidance simulations, satellite thermal response, and polynomial curve fitting. Engineers interested in projects applying advanced display techniques are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division



Washington Roundup

Anti-missile Race

U.S. is keeping ahead of Russia in the all-out effort to perfect an ICBM defense, but offensive generation techniques are expected to stay ahead of countermeasures, in the view of Defense Dept. experts.

Dr. Harold Brown, Defense Dept. research chief, recently told the House Defense Appropriations Subcommittee that the advantage missiles have over defense probably will be more apparent next year. But he noted the interceptor: "The major part of our missile forces as presently programmed will penetrate any defense which could be deployed in the next five years."

Designs appear to be better penetration aids than maneuverable missiles, and the latter will be "pushed carefully" starting this year, Brown said. Air Force long has planned for acceleration of Project Phoebe, designed to develop a maneuvering ballistic missile (Slam), and emphasized its penetrative ability.

Defense leaders are trying their best for a balanced defense program in the anti-missile missile effort this year. They argue that no missile defense would be complete without shelters to protect the population against fallout from missiles properly exploded outside defended areas.

Russian Space Test

Russia plans both hard and abroad that Russia is about to launch a space spectrometer, but predictions of just what it will be range from a seismometer and docking attempt to two space ships to the shooting of a nuclear warhead.

But no matter how spectacular the test, congressional leaders still insist they will not let the U.S. space agency budget substantially. Senate space committee, which traditionally releases early in its House counterpart, made it plain in a confirmation hearing last week that some cuts are in order. President Eisenhower went in far as to tell Republicans congressional spending \$40 billion to get in the moon was just plain "silly."

V/STOL Inquiry Brief

Chairman John Stennis of the Senate subcommittee investigating the X-22A contract award to Bell (see p. 32) has no intention of prolonging the hearings to re-examine the award being considered by Sen. John L. McClellan on the TFX. Sen. Stennis plans to conclude the inquiry as soon as possible, even to not calling officials of the two companies unless they themselves request to testify.

Sen. McClellan promptly held off his TFX hearings last week to afford the X-22A inquiry maximum publicity. Bell hearings are now focusing on the Kennedy Administration, and have turned Defense Secretary Robert S. McNamara's name at the helm as irretrievable as a computer. This is the main reason the Administration decided to have Deputy Secretary Russell L. Gajet take over only as the X-22A hearings rather than use the main witness until last, but in the TFX investigation.

One of the main issues in the parallel investigation is that the aircraft decision-making, McNamara on the TFX and Gajet on the X-22A, were among the few who did not receive technical briefings on the rival proposals. A big reason why Gajet rejected Douglas was because of his opinion of the firm's performance on Skystar.

Test Ban Prospects

Key for arriving at a U.S.-Soviet agreement banning atmospheric and underwater nuclear tests appears to be whether Chairman Nikolai Khrushchev will back off from his position on a complete ban.

Harold Wilson, British Labor Party leader, said after a three-hour meeting last week with Khrushchev that chances for a full test ban with the superpowers dissolved by the U.S. "are not very hopeful," but declared there was "more hope of an agreement" authorizing testing in the atmosphere, space and underwater. President Kennedy said the U.S. will not conduct atmospheric tests "so long as other states do not do so."

U.S. and British officials will go to Moscow in July to try to negotiate a treaty with the Soviets. W. Averell Harriman, under secretary of state for political affairs, will lead the U.S. delegation while Vassili Bubarin, minister of defense, will direct the British team. A resolution sponsored by 54 nations favors banning atmospheric and underwater tests and declared that any cheating would be detected without mutual inspection.

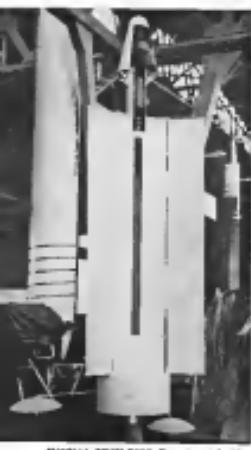
Dr. Albert Bahn will be named assistant secretary of the Air Force for research and development, a post left vacant when Dr. Buckner McMillan moved up to under-secretary of the Air Force. Dr. McMillan, an armaments engineer and former USAF chief scientist, comes from Cornell Aeronautical Laboratory, where he was vice president.

The seven engineers from the Manned Spacecraft Center who developed the Mercury spacecraft—Wernher S. Blaupunkt, Jr., Robert G. Gilhous, Martin Faget, Jerome H. Haunman, Caldwell C. Johnson, Jr., A. B. Krikor, Andre J. Meyer, Jr.—obtained a patent on the capsule June 18—the day the space agency announced the Mercury project had come to an end.

—Washington Staff



SPECIAL FRENCH SPACE PAVILION at the Paris Air Show housed 37 exhibitors, both government and private. Marin is foreground of the Diamant three-stage boost vehicle. Véron banner is at right and fuel sounding rockets are at left.



SNECMA-DELTA 2065 Gossamer television relay satellite shown in model form.

French Government Plans

French-Government, with strong right-wing opposed, prestige and potential industrial technological fallout is ruled, a developing a broad national space program that should establish it as West Europe's leader in this field within just two years.

Begun with FR.1, to be launched from the U.S. Pacific Missile Range in late 1964 or early 1965 with a secret booster, and the National Aeronautics and Space Administration, the French plan to move quickly towards placing five academic satellites into orbit, using nationally developed boosters and boosters.

Launch sites located in metropolitan France also will be developed, and other satellites beyond the initial five will be designed and placed into orbit.

First all-French satellite and launch system, the FR.1, is scheduled to be tested in early 1965 by the SEREB-developed Diamant three-stage booster. The launch site will be at Bourges, central France, near Paris' Charles de Gaulle-Orly airport.

Four other academic projects already have been formally designated and approved by the French government.

The planned space assault, with de-

tailed European, is being organized largely along established U.S. patterns. Booster development and launch techniques remain largely, in the hands of the industry, with the payload design responsibility assigned to a new, and growing government agency called the Centre National d'Etudes Spatiales (CNES), whose management parallels that of NASA's Goddard Space Center, according to officials here.

Like Goddard, CNES will retain much of satellite and payload design responsibility but will contract with private industry for most of actual development and production, and a number of traditional French defense firms already are becoming deeply involved in the space program.

Merced Diamant, for example, is working on several electronic projects, and Hispano-Suiza is developing a signal guidance system. Nord Aviation is producing the FR.1, while Sud along with SEREB is working on booster with and Petrel is producing high-altitude research balloons.

As an indication of the importance France attaches to space effort, CNES President Jean Cauvin has reported directly to French Minister for Scientific Research Gaston Palewski who, in



DIAMANT BOOSTER, above left, has a liquid-fueled first stage and solid-propellant second and third stages. The first two stages are SEREB-developed and Sud has designed the third stage. French FR.1 satellite, right, will be launched by a Soviet booster.

West Europe's Most Extensive Space Effort

turn, reports directly to President Charles De Gaulle.

CNES' diverse air and space organizations of a number of universities and research institutes, and these organizations will be called upon to make substantial contributions to the space program as a whole.

Diamond slightly over a year ago, CNES soon has approximately 100 human resources at its Paris headquarters, general new personnel categories, according to one official, growth to "several thousand" employees during the next five years.

The extent of government support and understanding of the need for a strong national space program was indicated here last week by Palewski.

CNES projects already approved include:

- FR.1 satellite, built by Nord, which will be launched by NASA's Scout rocket to orbit at an altitude of 150 mi in late 1964 or early 1965. The payload—three experiments designed to measure the earth's magnetic and electromagnetic fields—is being designed by France's Centre National d'Etudes de Telecommunications (CNET), a department of the postal ministry, with CNES responsible for integrating the package into the satellite shell.
- PROPOSED FRACHTON SATELLITE system developed by SEREB would be used primarily for solar and nuclear power research.



PROPOSED FRACHTON SATELLITE system developed by SEREB would be used primarily for solar and nuclear power research.



British Display Variable-Wing Model

Models displaying British Aircraft Corp.'s concepts of a variable wing span, which the company is exploring under a Ministry of Aviation contract, were displayed at the Paris Air Show. Current configuration of the model probably bears some resemblance to the still secret TSR-2 tactical strike reconnaissance fighter being developed for the Royal Air Force.



Sud Assaut Helicopter Mockup Shown

Sud ST.511B assault transport helicopter, now under development, is shown in mockup form at the Paris Air Show. Helicopter, with long doors on either side of the fuselage, is built around a spacious seat and will carry 22 passengers and a crew of two. It will be powered by two Turbomeca Turmo 5s.

external solar cell power units which will be purchased from the U.S. since French industry still is lagging in this area. Data received will be provided to two on-board telemetry units, including an advanced system developed by CNES.

As a prelude to an actual orbital flight, an FR1 payload will be launched to an altitude of between 125 and 137 km from NASA's Wallops Island, Va., in the summer of this fall.

• **FR2**, first satellite to be launched by the French, is another payload for the flying laboratory for the French equipment involved. One scientific version attached to the Dassault's third stage will report on the booster's characteristics and fuel systems, while the satellite itself will carry experiments to measure radiation and effects of radiation damage to external solar cells. CNES officials now estimate that radiation, including the increased intensity resulting from U.S. high altitude nuclear explosions, will destroy about 20 percent of FR1 solar cells within three to four months, decreasing all communications with the satellite.

FR2 also will carry several instruments operating on various frequencies to test an atmospheric balloon experiment. Total payload of the satellite will be 77 kg.

• **FR3**, also a flying laboratory for the French system involved, essentially will be a scaled-up model of the FR1. The payload weight will be increased to 98 kg.

• **FR4**, the first French satellite, is which attempts will be made to break new scientific ground, will carry a payload designed to measure hydrograph distribution in the upper atmosphere. A measuring device was developed by Paul J. E. Bérenger of CNES. A similar balloon-designed experiment will be used aboard NASA's Explorer 33.

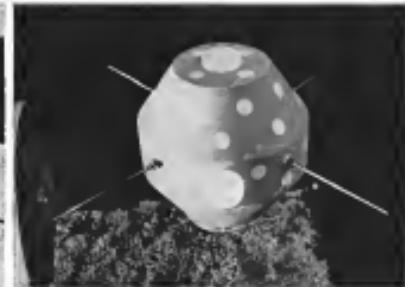
• **FR 5** will be launched by the Dassault to study magnetospheric regions in space and will be equipped as a laboratory for future research.

• **FR 6** will be a solar-tilted satellite, but the final payload will not be determined until CNES officials have had an opportunity to study results obtained from earlier satellite science experiments. CNES officials are studying several proposals for satellite orbit designs, but the final decision in this area has not yet been made.

In related research effort, France's Centre d'Etudes et de Recherches de Météorologie Atmosphérique (CERMA) is studying various aspects of space weather. Unlike the other French branches of aircraft and satellite research, although CNES does it, it has no interest in space as an orbit. London began with it in 1962, a year it is scheduled to



CAT-CARRYING VEHICLE, above left, will be launched into a selected trajectory later this year as part of French space method research program. DASSAULT satellite, right, built by CNES will be used in lots of the Dassault booster.



be placed in orbit, hopefully sometime this year under the Veneron booster. A module will be launched in 1967 with the Diamant rocket.

French scientists also plan to measure information transmitted from NASA's Nimbus weather satellite and will take this data over to the French weather bureau.

In the satellite field, the French space program and others, as shown in table, include a number of other proposed satellite designs from private industry which have not yet received formal government support for final development.

These include the Phasor for solar and nuclear energy research developed in Sweden; the French Space Research Reactor (SERFR) to be study by CNES and the SNECMA; Gossamer-24, a microsatellite orbit reference solar sail test bed. The Phasor, if approved, would be placed in orbit with a 30-kilogram payload to the center by the Dassault with an orbital period of 1 hr, 40 min. Power would be 745瓦 and the project \$50 million.

Several companies also are looking into the present jet research field.

So far as man in space is concerned, CNES President Coindet emphasizes that the government in general has no interest in this area. Commercial development requirements for such an orbital vehicle, Coindet says, is more in this direction would be "disastrous" for the French program. A project of this magnitude, Coindet says, would probably cost off all currently anticipated French space funds and probably would be prohibitive than those already obtained by the U.S. and Soviet Union.

Present Dassault configuration, designed primarily as a nuclear weapons carrier for the military, has the capability of placing a maximum 176-kilogram payload into orbit, while the second-

generation design under study by SERFR is scheduled to be operational by 1967-68 should be capable of handling substantially larger payloads.

Current Dassault has a three-stage height of 33.4 ft and a launching weight of approximately 10 metric tons. SERFR-developed first stage designated Diamant uses a liquid fuel mixture while the Dassault second stage and the third stage uses solid propellants. The first stage incorporates wound glass fiber construction and both the nozzle and the body incorporate monolithic techniques.

Advanced Dassault would have four launching modules as opposed to a single one used on the present version. The first stage would have a thrust of 40 metric tons as compared with 15 tons for the current one. The first stage also would be a solid propellant and all three stages would be built in SERFR's design.

Under the French space agreement signed with Algeria, Frasier says the Saloua launch site until July, 1967 and Coindet says there is a possibility that the Algerian government might permit "possible" use by France. After that, CNES drugs at present are conducted under French army auspices and control.

To pursue the 1967 negotiations with the Algerian French heliports, the French are now in consultation, construction of a site along the South Atlantic coast of France and Coindet says it would be available for use by CNES. The range, however, would prevent launching only to the north west, effectively destroying the earth's rotation and the resultant gain in payload weight.

To provide for this in the event

monitors from Algeria are no longer feasible, Coindet admits negotiations for use time extensions probably would be lengthy. Frasier also is considering the possibility of establishing a second site in the Pyrenees area along the Mediterranean in the region of Roselend near the town of Levens.

France also is planning construction of an even tracking network, perhaps later through Africa, although it will likely primarily open NASA's Minuteman system for data collection from FR1.

CNES engineers now are making surveys of Africa and other areas, including the Comoré Islands, to determine the best locations for four tracking sites which will form the basis of the French system.

French monetary contribution is divided evenly between its national program on one hand and both the cooperative ELDO and ESDR programs on the other.

Unless ELDO wants the Dassault, Coindet reflected that France's only potential contribution would be the final development of an advanced version of the Veneron rocket as the second of three planned stages for the organization's booster unit.

So far as ESDR is concerned, Coindet said, the French national program might contribute upon other areas of the program, perhaps solar satellites and lunar probes to be handled safely by the multinational agency which has the task of developing common satellite systems.

Coindet predicted that the French government would complete approval of France's participation in both organizations in the near future.

In its rapid buildup, CNES has dispatched a number of scientists to NASA's Goddard Space Center for at least an awards study in their respective fields.



Breguet 941 STOL military transport, with flaps down lowered above, makes an STOL approach at the Paris Air Show. Landing was part of a display for French President Charles De Gaulle. Note extended landing gear.



Engie Motor Mermet 360 executive low-thrust aircraft, designed to carry five persons, has two 200-kg Lycoming engines. Below, Yugoslav Cubalit transon is exhibited for the first time in the West. Note twin sonic prop sections.



Prototypes of the French-German Transall C 160 medium range transport aircraft on display at the Paris Air Show. Two aircraft are built in France, the other in Germany, are now in flight test. Consortium partners are France's Sud Aviation and Germany's Weser Flugzeugbau and Hanseatic Flugzeugbau.

Paris Air Show Attracts Wide Aircraft Variety



Breguet 1150 Atlantic turboprop anti-submarine patrol aircraft, above, is shown with tail section modified for magnetic anomaly detection equipment. First and second prototypes of the aircraft have been modified to accept the MAD gear. Below is the Dassault Myrme 20 twin-jet executive transport, powered by two Pratt & Whitney JT12 powerplants. Alternative engines also are being considered (AW June 19, p. 90). The privately financed prototype participated in a number of flights during the show.



Navy Scores DOD Civilians' X-22A Role

By George C. Wilson

Washington—Navy made a blundered attack on the civilian leadership of the Defense Dept. last week when Adm. George W. Anderson, outgoing chief of naval operations, and the director of Defense Programs, "threw out" a cause and through overstatement, "disgraced" and "can only be detrimental to the competitive spirit of America's warfere."

Adm. Anderson expressed his concern in the form of a memo addressed to the State Department in investigating Subcontractor A that is seeking the award of the X-22A V/STOL

attack aircraft contract to Bell Aerospace Co. Navy had recommended Douglas Aircraft Co. as an excellent proposal but was "undeniably superior and changes to Bell" (as bid).

Other top Navy officials told the author Anderson's views, and said their fears Douglas should have been awarded the contract, which actually may total \$35 million. The only justification they had offered for giving the award to Douglas was, and was in a long letter from Deputy Defense Secretary Russell L. Galloway, who cited Bell's greater experience in the V/STOL field and past performance on other contracts.

Lack of Technical Data Cited in Award

Washington—Civilians defense leaders gave the Navy no technical reasons for awarding the service's most controversial contract, Douglas Aircraft Co. is awarded the contract for developing the revised V/STOL X-22A aircraft under Adm. Fred D. Stroop, who was also head of the Bureau of Naval Weapons during the competition, told the Senate Foreign Relations Committee last week.

Adm. Stroop and his top aide, Deputy Secretary of Defense Russell L. Galloway, got for awarding Bell Aerospace Co. over Douglas Bell's greater experience in the field and as bid "premier." The Bell proposal was the higher cost one (see *Flight*, June 7, 1962).

- *Bell's design is considered a high-risk venture.*
- *Neither design is considered a prototype for future procurement.*
- *Bell's design requires definition which must be added at the design stage before the program is started.*
- *The Douglas design is considered superior to the Bell design.*

Based on the above conclusions, it is the opinion of the chief of the Bureau of Naval Weapons that Douglas should be awarded at the lowest and awarded the contract for the revised V/STOL aircraft if we proceed with the flight vehicle program.

The Bureau of Naval Weapons has previously recommended that a program of component development for revised and prior to preliminary flight vehicle. The chart of the Bureau of Naval Weapons also indicates that the approach might be considered. The best design, Douglas, offers so much risk that a conventional flight test vehicle may not be achieved. Therefore, as an alternative program and one which probably offers substantially the better chance of achieving a successful initial component development is suggested. Although to initiate such a program at this time would appear to delay the flight research program and would require a greater expenditure of R&D funds, it would certainly have a greater probability of ultimate success and considerably could even save time in the long run.

It is therefore suggested that, instead of proceeding with the full scale program, the Bureau of Naval Weapons be directed to select the components only for development at this stage and that the flight research phase be contingent upon successful component development. If this alternative suggestion is accepted, in view of the complexity of the Douglas design, it is strongly recommended that Douglas be selected as the contractor for component development.

The Bureau of Naval Weapons is of the opinion that the X-22A V/STOL program is a national priority and the successful completion of which is in the national interest. The Bureau of Naval Weapons is prepared to implement any decision made in this area whether for an initial component test program or a full-scale flight research program.

Adm. George W. Anderson, chief of naval operations, expressed in Adm. Stroop's memorandum and forwarded to Navy Secretary Fred Korth, "sudden, unanticipated and uncommunicated" to Adm. Stroop and other Navy officials, but remained silent during the complete four months in which he had served on the board of directors of Bell. On June 16, 1962, Gilpatrick wrote a letter to Secretary Korth notifying him that Bell would get the contract.

The subcontractor's V/STOL profile is being called "the little DFX investigation" because of the many parallels that exist between the two proposals that contestants. One difference is that Defense Secretary Robert S. McNamara had told him to bid for responsibility, but however, the maximum recommended value of the F-104 USAF nose section would be \$10 million, which actually may total \$35 million. The only justification they had offered for giving the award to Douglas was, and was in a long letter from Deputy Defense Secretary Russell L. Galloway, who cited Bell's greater experience in the V/STOL field and past performance on other contracts.

Control wise in both Service interests, however, is whether civilian defense leaders are establishing new ground rules for procurement which strives to reduce the influence of the military to the point where U.S. fighting forces will receive nonlethal weapons. The X-22A investigation is one more example of Congress shifting air priorities from military to civilian defense leaders (AW, June 3, 1962).

Adm. Anderson's statement at the opening of the X-22A hearings here last week was the strongest public statement levied by a military leader during this Congress against certain facets of military procurement on major procurement. "It is my personal conviction," Adm. Anderson said, "that reversal of recent relaxation recommendations made on the basis of long-established and widely accepted procedures is required on two bases. First, the professional advice of military and civilian experts charged with the technical evolution of design proposals should not be ignored except for the purpose of flight and performance evaluation. Second, such research can only be demonstrated to the competitive spirit of American industry."

"For many years," he continued, "the Navy has attempted to foster and maintain that spirit at a high level as the belief that such will stimulate technological progress and innovation to insure that we insure the most effective weapons system and hardware available. It also considerations are to be introduced into what has been a lack of a truly competitive process, mainly due to the fact that the proposed rules under which they see to ask new development and production efficiency."

Adm. Anderson said the Navy is the best has conducted much design competition, "while good rules will understand and received by industry" and had represented as several in the past. He said the X-22A proposal was "a complete surprise" to Vice Adm. Fred D. Stroop, then chief of the Bureau of Naval Weapons. Both Adm. Anderson

How Navy Evaluated X-22A Proposals

Washington—Navy estimated Douglas could build two prototype X-22A aircraft. V/STOL, design for research costs for \$10,100,000 and Bell could do it for \$31,000,000, or a difference of \$17,000,000.

According to the June 1962, *revised memorandum* prepared by George A. Sprangberg, evaluation director for the Bureau of Naval Weapons, there were the other advantages the Navy saw in the Douglas proposal:

- Superior electrical systems. Douglas systems reflect for d.c. generators requiring no constant-speed drive as battery, while Bell proposed constant-speed drive and uses complicated alternator and transformer rectifiers.
- Transmission system. Douglas design is a "gearless" belt and pulley box gear design "a greatly preferred" because it is simpler, has more interchangeable parts and is more easily serviceable.

Bell proposed multiple unit arrangement "which introduces significant problems."

- Fuel management. "The fuel tank is at the top of the fuselage on Bell's design it is extremely low on Douglas' well-swept-off."

▪ Vision. "Driver's visibility below all around" for the pilot.

- Engine. Douglas provides better seats while the pilot in the Bell-designed vehicle would have to sit through a 30° nose-up pitch, sit atop a cross beam and then sit and sit again. "Bell's arrangement is undesirable," the memo said.

• Fuel economy. Bell's fuel economy is less than 10 percent, while Douglas would be presented due to layout of fuel tanks.

- Propulsion. Douglas "has already studied the desired fuel concept in greater detail and their proposal shows sound engineering solutions to many problems only discovered by Bell in general plan."

Sprangberg and Bell's agents would produce better because it was a 20.7-psi propeller compared with the Douglas 12.5-psi prop. Also, Bell's propeller has higher propeller rpm for hovering as a lower one for level flight, while Douglas propellers would have a constant 2,000 rpm.

Stroop and Sprangberg and Gilpatrick's letter directing Bell to be awarded the contract was so peremptory that they did not attempt to explain their reasons.

Subcommittee Chairman John Stennis (D-Miss.) said the alternative of the hearings is to determine "whether these were valid and compelling reasons for overturning the findings of the technical evolution of design proposals should not be ignored except for the purpose of flight and performance evaluation. Second, such research can only be demonstrated to the competitive spirit of American industry."

"For many years," he continued, "the Navy has attempted to foster and maintain that spirit at a high level as the belief that such will stimulate technological progress and innovation to insure that we insure the most effective weapons system and hardware available. It also considerations are to be introduced into what has been a lack of a truly competitive process, mainly due to the fact that the proposed rules under which they see to ask new development and production efficiency."

But last of hearings brought these decisions:

- *White House interest.* Dr. James E. Webb, President Kennedy's science advisor, was so interested in the X-22A project that Navy officials gave him a special briefing June 4, 1962, in the Executive Office Building. Adm. Stroop and his subcommittee was of a "sick mind," not an attempt to exist. White House pressure on the Navy to award to either contractor. Dr. James E. Webb, then assistant secretary of the Navy for research and development and Dr. George C. Wilson, director of the office of defense research and engineering, attended the news briefing. George Sprangberg, chief of the Bureau of Naval Weapons' evaluation division,

said within the Navy who directed long the conclusion that the Douglas proposal was superior to Bell's. He said that those evaluating the instruments to award the contract to Douglas and Dr. Webb, Anderson and Adm. C. V. Whitford, vice chief of naval operations.

- *Brown's accommodation.* Brown and he agreed the Douglas proposal was technically superior, but told Gilpatrick as a meeting June 13, 1962, that "since both contractors could produce an acceptable aircraft, one factor should also be considered in making a decision," such as "relative expenses and gross performance." The high expense is especially important in an experimental proposal which places engineering and design costs on the contractor. Brown and he made no more recommendations on which contractor should be chosen, but thought Gilpatrick's decision "was probably the correct one."

• *Economic considerations.* Wilson and the fact that Bell was located in Buffalo, N.Y., which had more established plant. Douglas' 2200-Lake-Long Beach, Calif.—was situated as distance below his level, but did not figure in the decision by Gilpatrick. Wilson endorsed the Navy's findings, which concluded the Douglas design was superior technically, but not bid. Bell's design was "the right one" because of other factors. Wilson said he arranged the hearing of Wilson because the aircraft was a two-year project.

Wilson told subcommittee in investigation that he does not wish to testify in the hearings, and Sen. Stennis has decided not to press the point.

Radio Disturbances

Disturbances of radio communications on radio frequency if disturbance has definitely been linked to wind shear associated with a 60 to 90 mph high velocity winds blowing in opposite directions above and below atmospheric levels of one mile altitude and acts as a barrier to radio signals in the disturbance this layer about four thick.

These reflect radio signals normally reaching the much higher F layer, according to the theory of an American scientist, J. D. Whitehead. The electron density profile measured showed the thin layer was associated with an eastward shear greater than the westward shear preferred by Whitehead.

These experiments, using Nio-Cup and Nio-Aspide sounding rockets equipped with Langmuir-type electrical probes were conducted.

Dr. Leslie G. Hines, of the Goddard Space Flight Center, told the experiments made contact to NASA's Goddard Space Flight Center



First Air Force CH-3C Helicopter Rolled Out

Five USAF/Hilleria CH-3C, recently rolled out at the company's Stratford, Conn., factory, has a hydraulically operated rear loading ramp for stable loading of wheeled vehicles (AW June 10, p. 79). Helicopters are amphibious and have a 2,000-lb capacity when no external cargo is being loaded. First flight is scheduled later this month. CH-3C will carry 25 passengers or 5,000-lb of cargo.

Weightlessness Effects on Cooper Cited

By William C. Wetmore

WATSON—Astronaut L. Gordon Cooper's insistence that he use hours and often sleeps on the Tibetan Plateau during his Mercury-Atlas 9 flight has now suggests that visual perception and judgment may be adversely affected by weightlessness, Dr. W. R. Adey told participants in the Terrestrial Life in Space Session at the Committee on Space Research (COSPAR) meeting here.

Dr. Adey, a member of the Illinois Research Institute of the University of California at Los Angeles, later amplified on that statement: "Whatever he saw, if his judgment was in good shape, as a pilot with thousands of hours of flying time he would know that it was absolutely impossible to see a 10-ft-dia object from an altitude of 10,000 ft."

Cooper's experiences, Adey said, probably was not hibernation in the usual sense but rather one due to a unique sense of well-being resulting from lack of gravity sensor input to his muscles and joints. In that situation he would also be in the so-called "aspects of the depth" occasionally experienced by divers—an occasionally experienced of mutual location could occur.

If the high altitude of the Tibetan Plateau—which is above a considerable percentage of the atmosphere—is thought to be a factor, Adey said, then some minor defective sensations must be considered, since the maximum elevation of the human eye at the end of 1 to 3 sec of sleep.

Moreover, a dark object would tend to be masked by the white background of the Himalayan snowfields, Adey said. "This situation gives an indication of the need for carefully designed, or tenaciously repeated, tests of human physiological phenomena arising from deprivation of external sensory stimuli," Adey said, which have not yet been part of the U.S. space program.

Dr. Adey's sensory deprivation experiments with piglet earpiece implants consisted of closing the animals from both data, taste, except for the one-day periods of light each day that were necessary to protect the animals' sense.

More recently, Adey has, by means of isolated sensors, evaluated better behavioral patterns, including choosing place leads and sleeping their heads. One animal was observed to obtain greater sleep by keeping spread and striking the top of his cage with his teeth. When light was shown on a reward box animals would pass right past it repeatedly for extended periods of time, often as long as 18 hr.

Results of several sets of reliability of human subjects under imposed sensory conditions were presented to the same COSPAR session by George Hasty of the Federal Aviation Agency's Civil Aeromedical Research Institute.

Veterinarians—who with but one exception were all military pilots—were invited to a 50-ft-dia simulated space

cabins for 30 hr periods. No communication with personnel outside was allowed, and any external voices were effectively masked by sounds from ventilation blowers. Cages perhaps were shortened to prevent visual contact with the outside, and subjects were observed by closed-circuit television.

The isolated sensors are meant to further impeach by forcing the subjects to concentrate their attention beyond the point of extreme fatigue in performance of tasks involving spatial discrimination, problem solving, vigilance and problem judgment.

Reliables of the majority of the subjects was not adversely affected. Hasty said, but certain others exhibited pronounced phenomena.

For example, one subject felt as though his hands and feet had grown to enormous size, and therefore experienced difficulty in manual operation of the task controls.

More recently, Adey has, by means of isolated sensors, evaluated better behavioral patterns, including choosing place leads and sleeping their heads. One animal was observed to obtain greater sleep by keeping spread and striking the top of his cage with his teeth.

When light was shown on a reward box animals would pass right past it repeatedly for extended periods of time, often as long as 18 hr.

Another subject entered a blanket into the chamber as a protection against incurrence of an electric shock which had terminated an earlier test. During the 22nd hour of his confinement he began shooting, "He's real hot, tell them to pull it out," the TV screen still on the TV set was turning all brown—the one thing right in front of me, right in my face—better turn it off in a hurry, it's gonna burn it all off."

Attempts by a technician to distract the subject from his anxiety over confinement fail in the normally-energetic TV monitor were fruitless, and the later

was removed from the chamber in a highly agitated state.

In this subject, who entered the chamber determined to prevent hibernation, nevertheless thought he saw the TV monitor floating weightlessly and had illusions of form in the dark of the total capsule. He attempts to react, however, probably were responsible for his learning to cope with the phenomena by looking over from them.

Solutions to these problems, Hasty concluded, may involve the achievement of steady improvements beyond such obvious techniques as communication with the earth, programmed instrumentation, data retrieval, etc. A more understanding of biological processes is needed.

Using COSPAR sessions focused on man-in-space as especially on Man.

Study of its life support system will further might into evolution of life on earth. Dr. G. Sieg, of Guelph, Ontario, told delegates, by comparing them to those of earth, it would be possible to determine the validity of the theory that in terrestrial and atmospheric modifier of microgravity by radiation pressure can occur.

However, Dr. Sieg said, only the sealant could then be transferred, over their time must be on the order of the wavelength of a proton. This means that for our sun, nuclear spaces would necessarily be too small to possess shielding for survival at deep space.

A more specific analysis for the annual quality of life in the solar system was expressed by Prof. A. A. Isidorov of the Soviet Academy of Sciences.

"We have no experimental evidence of the stability of fractal spaces, nor can in course due to ultraviolet rays," he said. "Without these data at our disposal we cannot state that transportation of biological spaces through a topographic space is impossible."

Gulfer, an instrument designed to detect and analyze life on Mars was designed by N. H. Hansen of the California Institute of Technology.

Key to that instrument lies in the fact that about 10 known species of life produce carbon dioxide which is easily detectable and then easily detectable by feeding them on a micro-carbonizing carbon 14.

Two such instruments—one for testing and the other for control purposes—would be incorporated into a capsule for landing on Mars. The radioactive nutrient would be contained in sealed capsules and the valve apparatus would be hermetically to provide inertial compensation.

After landing on Mars, capsule will fire propellants outward from the retrofire. Each propellant will deploy 25-ft lengths of silicon-glass-impregnated cable. Gulliver's capsule will then and

the cool and sheltering Martian soil into an incubation chamber. After the chamber is sealed, the capsule will enter a glassy carbon medium retained onto the capsule.

Any organisms contained in the soil sample that are able to metabolize the nutrient will produce radioactive carbon dioxide. This gas will be detected by a thin window Geiger tube and the data will be transmitted to earth.

Accelerated contamination of other planets—particularly Mars—by space-craft-borne terrestrial microbes is a major area of extensive research for microbiologists.

Experiments conducted by R. S. Young, P. H. Del, J. Bell and J. L. Allard at NASA's Ames Research Center have demonstrated that certain types of terrestrial microorganisms can survive in simulated Martian environments.

These experiments simulated a frequent environment ranging between -176° and +21°C during dry, light illumination of the Marsian equatorial summer.

To preclude contamination, careful study is being made of methods for sterilizing specimens. Several are in use at the present moment at the center, including the use of heat, radiation and chemical techniques.

One such method, called geochrono—sterizing, has been devised by Prof. E. F. Sieg of the Albert Einstein College of Medicine. This is vapor aluminization of spacecraft in a sealed environment enclosed by a mechanical barrier, or radiator—a technique which has been used to sterilize ground-borne microorganisms.

Another method, which would consist of a flexible film, which would permit use of rigid supports for the spacecraft components, has been made available. Gloves and even suits could be built into the walls for testing, repair and assembly.

For more complex operations, a technique would use a pressurized vented suit and enter the payload area through a gaseous leak. Chemical agents, such as ethylene oxide or potassium acid, would be used to sterilize the equipment.

This technique could possibly be used for repair and mating of parts even on the launch pad without need for sterilization, Decker said.

Other highlights of the COSPAR meeting include:

• Snow in the Martian atmosphere has been detected by means of spectroscopic studies conducted in the Soviet Union. This phenomenon is concentrated around the region of the polar caps, N. A. Kurnov said.

• Two dunes have been discovered in the earth's gravitational field in the course of positive studies of images of eight U.S. landers, according to Prof. P. W. Whipple, director of the National Aeronautics and Space Administration's Laboratory. Images of these phenomena were given as off the west coast of Mexico and north west of the tip of India.

• Evidence of gravitationally-trapped, high-energy proton zones is to be dependent only on atmospheric density, coupled with the boundaries of the magnetic moment moment, Prof. S. Fred Singer of the U.S. Weather Bureau reported. Consequently, boundaries of the solar wind bands of many years are possible for protons trapped close to the earth's surface.

• One of the most important associate bands to spanwidth, band, is to be dependent on the temperature of the solar wind, reported by Dr. W. R. Adey, of the University of California at Los Angeles. Adey said, "The width of a band of a specific frequency is dependent on the temperature of the solar wind, which is to be expected from the solar wind.

• Indirectly, the width of a band of a

Bell Wins HX-1 Competition

BELL Helicopter Co., Ft. Worth, has won the USAF HX-1 competition for a medium-size support helicopter with the company's modified UH-1B transport model. Bell is over the Kansas HX-1 bid for the contract, estimated by informed sources of \$100,500 million over the next four flight years.

Although the number of orders was not disclosed, it is reported that 197 transport helicopters will be produced with fiscal 1983, 1984, 1985, and 1986 funds, and 35 are being ordered in fiscal 1987 and 1988.

Contractual control of the program is to be shared by the Defense Systems Agency, which will be responsible for performance of the mission.

Initial proposals were filed by Bell, Kaman and Sikorsky last November. Kaman denied that one of these entries and its requirements and proposed further proposals which were submitted in February. Sikorsky did not enter this second phase of the competition.

Winning Bell proposal will deliver four transport helicopters by the end of the 1986 fiscal year (AW Apr. 28, p. 80) and will be produced by a General Electric T53-GE-100 derived from a 1,250-shp to 3,180-shp

At present version of the UH-1B will be fitted with a cargo loading system and will carry up to 18 passengers and a pilot. Initial deliveries will start next year.

Half of Midas Spending Viewed as Waste

Washington—About half of the \$473 million spent through fiscal 1981 on the Midas strike program has been wasted, in the opinion of Dr. Harold Brown, director of defense research and engineering.

He told the House Appropriations Defense Subcommittee in hearings November 16 that the money was wasted on "ineffective system" internal hardware. "The USAF Lockheed Midas project is an attempt to equip aircraft with infrared sensors capable of detecting missiles during launch (AFM, Sept. 24, p. 54). USM approved \$750 million for fiscal 1984 to carry Midas apparatus, but Defense Secretary Robert S. McNamara approved only \$15 million on Brown's recommendation.

Brown said that the Midas program has been severely cut back because the way the weapons system worked, it would never produce a reliable, dependable system. "What could happen is that within a year or two the cancellation of the program may result in obtaining the basic information which will then enable us to go to some other system. It would be a very different system from the one originally proposed."

Delta Gains

The other half of the \$473 million, Brown said, has been spent on gaining data which are also necessary for any system. "But this other half may not be used in the final form that is going to be applicable." He said that Aerospace Corp. is now directing the program, but that Lockheed is still the project contractor because of the knowledge it has acquired. "The new office of the Air Force gives me, not great confidence, but reasonable confidence" about the future success of the program.

Subcommittee Chairman George H. Mahon (D-Tex.) questioned string Lockheed around on a point. "The company has failed to perfect the detector. To go back to a contractor that has failed, and to an organization that has failed, and to people who have failed to solve the problem, seems to be somewhat questionable," he said.

When asked why subcontractors measure only 100 cent to 100 cent to find out the shortcoming at Midas, Brown replied that each "All-in-one" launch had cost between \$10 and \$15 million, for a total expenditure of about \$180 million. He said part of the reason for the program's failure lies in the "assumptions that were set up" to start Midas to be large.

We didn't know enough to be able to go for a system as complicated and demanding as the requirements when we set up the program," he said.

Rep. Mahon and Brown disagreed over the importance of the extra 10 mm warning of a missile attack that would be provided by a perfected Midas. Thus was the exchange.

Rep. Mahon. It seems to me, Dr. Brown, that to some extent you have sold this idea short. It seems to me that we underestimate [Midas] there was hardly anything of greater ingenuity than it was. In other words, we wanted the earliest possible warning of a ballistic missile attack. We were told that [Midas] would discover the launch, not when the weapon was in the air and headed toward us, but when the launch of it. So we are now dependent on the launch of the missile to trigger the system. This seems to me to be the greatest ingenuity. So, in some extent, if you will, you can argue that here was a case where consciousness was worth nothing and that the system which was put into the deployment aspect of this weapon, while actually wanted, could not be an strength of the organization, have been thrown at the time that it would be wasted.

Brown. I think that this is a matter of judgment here. A number of people, both in the Air Force and on my own staff, for this is quite important in civil defense and in protecting the civilian structure in war. The trades that I have seen that look at what at what people would do with the extra time do not suggest that, in my view. That is, the difference between what it would take 20 min warning, 30 min, 45 min, 60 min, is not that great. I think, I think that I agree that the is a matter of judgment, and different people can have different judgments.

Time Element

When I look at what you can do to preserve the composed structure with this extra 10 min, what you can do to get more people into shelter and what you can do to take the airways off as they are not flight on the ground, the last one seems to be much the most important.

The full subcontractor discussion of the Midas program was recently revealed, prior to hearing Mahon, when the same Midas was used. After the Air Force defense of charges that the program was wasted was sheltered from the public record. It was clear despite the defense of the project, some funds from the record that the Midas was under development.

At one point Chairman Mahon and the experience with the project is related kind of the line in literature. "He Midas has earned all its gold," Rep. Mahon added. "It appears to me we have been using a lot of gold."

and less important to Mr. McNamara, because as you go to an increasing fire rate, the number of missiles that each will release in attack, you are less likely to be completely surprised and wiped out. In other words, the extra 10 min was particularly useful for getting weapons off the ground. That was very important. It is still important, but it is not quite so important now when we have a substantial missile force as well.

Rep. Mahon. You seem to downplay the importance of the 10 mm of warning because, you say, we are driving more over missiles and less over surfaces, and we have these missiles to some extent unpredictable or launched considerably, and the 10 min are not so important. But the 10 min are important in the living, probably, a lot of these missiles are launched with civilians and the safety and security of our people. I do not think that you can very well overestimate the importance of that extra 10 min if you can get it.

I think that this is a matter of judgment here. A number of people, both in the Air Force and on my own staff, for this is quite important in civil defense and in protecting the civilian structure in war. The trades that I have seen that look at what at what people would do with the extra time do not suggest that, in my view. That is, the difference between what it would take 20 min warning, 30 min, 45 min, 60 min, is not that great. I think, I think that I agree that the is a matter of judgment, and different people can have different judgments.

Weapons Advances

Washington—Dept. of Defense Dept.'s research director does not optimism in major breakthrough in weapons over the next 10 years to have occurred during the past 10 years, partly because it is unlikely there will be increase in explosive power comparable to the jump from TNT to the atomic and hydrogen bombs.

Dr. Harold Brown, director of defense research and engineering, told the House Appropriations Subcommittee that "the combination of high laser, nuclear and hydrogen warheads have had a very big change, and these have been a lot of robbery [sic] changes. In a real war, the number of changes, to me, is robbery [sic] to the point that, Dr. Brown, "I am not sure that we have had a real level of nuclear advances. The future, I think, holds also some surprises and some advances, but the number of revolutionary changes we can foresee is not likely to be large."

Japanese to Re-study U.S. Sage Systems

Tokyo—Japan's Self-Defense Agency is sending a technical survey team to the U.S. this month to study small-scale Sage systems prepared by Litton Hughes and General Electric for Japan's early warning and air defense control systems (AW, Apr. 15, p. 31).

Kenjiro Suga, director of the Defense Agency, ordered the survey because of the agency's inability to decide which systems to buy. Award of the contract had been expected as early as last week, but final decisions now are not expected before early July. The program to modernize Japan's air defense system has been under study since 1979.

Toshiro Matsuda, chief of the Air Staff, favors the Litton system, but civilian defense experts favor the Hughes system, which is SHR-6000 electronic. They argue that the SHR could just about equal eight F-14Bs or two destroyers with the difference.

There is some apprehension within SDA, however, that development of the Hughes system, the only one not in the U.S., may not be completed in time. Japanese are concerned that two test problems may remain which will have to be solved after delivery.

CEI seems to be in out of the competition because its price, \$57 million, is higher than the second \$50.6 million Japanese budget. Costs of the Litton and Hughes systems are \$47 million and \$71 million, respectively.

Storm Area Photos By Tires 7 Planned

Washington—Tires 7 meteorological satellites to be launched for Japan this week are to permit the satellite to obtain earth cloud data and pictures over land and tropospheric forcing areas during the forthcoming tropical storm season.

If the launch is successful, it will

set a few record seven successful Tires

satellites in seven straight, and 15

straight successful launches for the three-stage Douglas Tires-Delta booster. National Aerospace and Space Administration (NASA) said Tires 7 is to be launched into a 450-km orbit at an inclination of 55 deg to the equator. The 297-kg satellite will have two cameras with wide-angle-101 deg-Euler lenses. The cameras will cover a large area about 250 km, on a table-top when the satellite is pointed straight down. Tires 7 also will carry two solar panel experiments to measure the earth's best balance and an electron temperature and density probe, the last experiment to be carried on a Tires



Shrike Mounting on Skyhawk Shown

Navy Shrike anti-infrared missile is shown suspended from a pylon under the wing of a Douglas A-4D Skyhawk. The weapon is designed to have a hunting capability against radar and other electronic countermeasures. Texas Instruments is the prime contractor for the missile, which is being produced for Navy's Bureau of Weapons.

News Digest

Vickers-Armstrongs last week told Northrop Aerospace it would reprice Nascom's fleet of 11 Viasat radio prop transports under the current service agreement to put the approximately \$7 million it owes the manufacturer into escrow. The Viasat agreement came during early negotiations before the U.S. Air Force's finalized its contract with Northrop's Florida unit (AW, June 3, p. 37), and underscored the aircraft's financial distress.

Ford Aerospace Div. has been awarded a \$96.537 contract to study the requirements for a Mars excursion module to land, live, work, and return between a environmental module orbiting the planet and the surface of Mars. The study contract was awarded by the Manned Spacecraft Center in Houston.

Indra government is considering dropping its program to manufacture the Avon 140 in favor of licensing the Pratt & Whitney Canada 2000. Avon management said the Canadian engine's better high altitude capability, for operation in mountainous areas is a major factor in the decision. Located manufacture of Avon 740 will be a limited part of Indian industry. Defense Minister K. R. Nairan Moon.

General Aeronautic Engineering Corp. has received \$88.4 million in additional funds from Novia BeWeps for A-6A/kounder submarine strike aircraft. Fund

ing converts a letter contract to a firm fixed price contract. Previous A-6A contracts total \$160 million.

Sikorsky S-61 hover-turbine-powered helicopter will be offered for sale outside the U.S. with a Boeing/Sikorsky/Garrett powerplant package in replacement for standard out of two 3,250 shp General Electric CT75 110 shaft turbines engines. West Germany's state-owned consortium will order six S-61 (AW, Jan. 10, p. 36). Chinese version package will be shipped to the U.S. next year for installation in an S-61 prototype.

Space Technology Laboratories, Inc., Redondo Beach, Calif., has been awarded to build four Pioneer planetary spacecraft for the National Aeronautics and Space Administration, at a cost of about \$15 million. Launch of the first 100-km satellite is scheduled for early 1984 on a Douglas Tires-Delta booster. Previous four Pioneer 10 and 11 of the U.S. participation in the Year of the Quiet Sun are in gather information on the effects of solar activity on the interplanetary environment.

Total of 24 epoxate outcures have been issued by USAF's Electronic Systems Div. to solicit proposals for installation of electronic data processing systems to be used in base inventory control at 152 Air Force bases throughout the world.

U.S. Participation in Concorde Proposed

Time lag, American SST program cost may lead Kennedy to approve joining in Anglo-French effort.

By L. L. Doty

Washington—Surprise move to bring the U.S. into the Concorde super sonic transport program is making strong headway.

The plan, developed in less than one week, was to reach top governmental levels late last week. It must have the approval of President Kennedy, French President De Gaulle and British Prime Minister Macmillan before it can be moved into an operational phase. The idea is known to have strong support of British and French government officials, and it is highly possible that the substantial costs of establishing a supersonic transport program as a single-nation project (AW June 10, p. 40) will force U.S. Concorde participation.

If the plan is approved by the U.S.—and the likelihood is strong—quick implementation of the program can be expected. The British and French are determined to build the Concorde at all costs, since the supersonic project is regarded as a national effort, and the anxiety from both countries from becoming secondary partners.

Both countries are fearful of U.S. competition in the supersonic field, since a successful U.S. strength would deprive them of the lucrative U.S. market. One of the escape clauses in the Pan American World Airways contract with Sud and British Aircraft Corp. for the purchase of six Concordes provides that the money will be released from contractual obligations if the U.S. decides to build a supersonic transport.

The U.S. government is concerned at the moment that a supersonic transport aircraft of the nation's aircraft industry is to return to the stage of competition with foreign manufacturers. But it now appears that the construction of a supersonic transport capable of speeds close to Mach 2.5 may prove economically unfeasible and the U.S. has a small window from the French that it is desired that the program is to be also denied if it is found that the proposed aircraft cannot be built at a practical price and operate profitably.

Thus, it is very possible that the U.S. will decide to build an aircraft, but be unable to stay with the Mach 2.2 limit. The same speed range is that of the Concorde. In such an event, the British and French will have a strong competitive advantage over the U.S., since the development of the Concorde is already about two years ahead of any possible U.S. effort.

None of the three governments can be expected to view a duplicate program of a costly airplane aimed at a

the contract between Pan American and the two European manufacturers a financial and escape clause are unacceptable. Concorde's penalties are slight: \$750,000 minimum, 150,000 maximum. Technical and performance data are not covered in detail.

Acceptance of the existing proposed revised management contract in the U.S. supersonic transport program, promptly led to the birth of the supersonic plan and re-emphasized the fact that the U.S. program had been allowed to lag. It was because of this last point that Federal Aviation Agency Advisor to the N. E. Huldy called on Pan American President Juan T. Trippe to attempt to dissuade him from ordering the Concorde and, later, to urge him to withhold the order announcement (AW June 10, p. 40).

Strongest force behind the U.S. proposal is Vice-Vice President Lyndon B. Johnson, who not only wants to put the project into action but would prefer to see the U.S. undertake a Mach 2.2 program.

The British and French are working in close cooperation on the Concorde project, and are not allowing the curative function that exists between the two countries to interfere with that cooperation. The approach to Pan American for the Concorde was made by Sud, with the full knowledge of IAC.

Lockheed SST Claims

Lockheed Aircraft Corp. official said last week that his firm could develop a 2,000-km/h supersonic transport in 4 to 6 years if a go-ahead were given.

Mr. Mel T. Clegg could be in Paris as early as 1975, carrying 110-125 passengers nonstop between Paris and New York in 2.5 hr., using existing airports, revealing in Richard R. Shopp, Lockheed California Co.'s chief advanced research engineer. Concorde's flight test and initial certification would be made with a layer of fuel as oxidized sulfur, the fuel that makes SSTs to hold supersonic speeds in 1970.

Lockheed has been engaged in supersonic transport research since 1964, and has evaluated more than 100 configurations. Shopp and Government procurement of a large part of the research and development phase of the supersonic transport program is essential because of the program's magnitude.

Meanwhile, Boeing Co. and Lockheed Aircraft Corp. presented technical papers on supersonic transport to the National Aeronautics and Space Administration last week. Both companies are engaged in analysis of four concepts for a supersonic transport.





When he carries an umbrella, carry an umbrella.

This is our man in charge of knowing if it's going to rain.

And to give you an idea of how accurate he is, we can tell you what a 300-foot ceiling will change to 800.

Of course, nothing in this fine makes a little change.

Every 6 hours (every hour for sup-

plies areas), we make up new maps

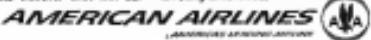
for sky condition, ceiling, temperature, dew point, precipitation and dewpoint pressure from 700 different Weather Bureau station reports.

Which means you will only know the weather your flight will fly through, but also the weather that will set

in for thousands of miles.

It might also interest you to know that we have 49 men in meteorological and every one either has a degree in it or goes up into the field. 50 have been with us over 15 years.

And when they carry umbrellas, we all carry umbrellas.



from a master station and three slave transmitters positioned in a triangular pattern, each approximately 75 mi. from the master. The master used by New York Airways is at Teterboro, N. J. Slave sites are designated airports that have been cleared by the Federal Aviation Agency at Newark, N. J. The signals from a hyperbolic grid pattern, with about 2,000 ft. between the parallel grid lines.

Visual read-out is backed up by Deco-cause dials which take bearings off the stations and provide the pilot with a cross-check on his sterile zone.

New York Airways hopes that the Deco system will prove acceptable for IFR operations to a maximum of 100-ft. ceiling and 4 mi. horizontal visibility. However, sources close to the program feel such minimums are unlikely for initial IFR certification, and that the next year can be hoped for 200-ft. ceiling restriction.

Second Evaluation

The current program is the second in which FAA has evaluated Deco for helicopter operations.

In the first, with the semi-autonomous on the V-44, FAA judged the system nonoperable (AW, Feb. 22, 1960, p. 41).

New York Airways hopes that the difficulties on the V-107, the improved operational reliability and the additional experience gained over the first evaluation will make the system more acceptable to the current trials.

There is little chance that it will be approved as an enroute navigation aid. Although much criticism about its use in enroute operations like British Airways' Airspeeder Darts has not been adopted in a general regulation and by the International Civil Aviation Organization, as far as VORs. Spokesmen within the FAA say that if New York Airways is certified to operate IFR, a VOR certification probably will also be required.

Regardless of the problem posed by the use of VOR in such areas as Wall Street and the proposed Pan Am Building rooftop heliport (AW, Mar. 27, p. 36), FAA officials stress that it could be important for operations at the city's major airports, LaGuardia, Idlewild and Newark.

They stress not yet certified as the V-107 and which Gallagher has an interest in for the ultimate in IFR operations, is an autopilot and a precise blade leading indicator.

The last model LSH, modified for helicopter use, appears to be working well as an autopilot. Gallagher said, "Costs are down, the cost of the system. In installation of such a unit are already available on the V-107."

The author has expressed interest in

U.S. Airline 1962 Turboprop Engine Maintenance Costs

Dollars Per Total 100-120 Seats/Hr.

| | ENGINE MAINTENANCE EXPENSE | | | | | Total Engines Hours |
|--------------------------|----------------------------|----------|----------------------|--------------------------|----------------------|---------------------------|
| | Total | Salaries | Deplete- Expenses | Wear- and Material | Overhead Expenses | |
| CAMERON C-47's | | | | | | |
| Seasonal | \$1.19 | 4.63 | 5.14 | 0.49 | 15.79 | 68,300 |
| Flight Tests | 25.20 | 1.03 | 10.87 | 0.28 | 4.23 | 114,128 |
| Block | 32.45 | 1.41 | 16.44 | 0.49 | 17.88 | 31,140 |
| ELCRAIS | | | | | | |
| Northwest | 13.58 | 3.34 | 1.87 | 2.82 | 1.65 | 146,529 |
| Southwest | 13.20 | 3.34 | 12.04 | 0.49 | 0.80 | 131,144 |
| Region | 17.49 | 2.60 | 11.39 | 3.99 | 2.00 | 278,488 |
| South | 91.19 | 1.84 | 18.09 | 0.64 | 8.79 | 44,000 |
| Western | 21.73 | 0.13 | 17.37 | 1.26 | 0.80 | 128,148 |
| Airamerica | 34.95 | 1.20 | 20.84 | 0.43 | 2.00 | 264,146 |
| CV-240 | | | | | | |
| All American | 38.98 | 2.47 | 10.91 | 1.18 | 0.70 | 4,800 |
| McDONNELL Douglas | | | | | | |
| 4-6000 | 2.00 | 1.29 | 0.93 | 1.45 | 0.80 | 475,326 |
| 4-6000 | 2.45 | 1.44 | 0.97 | 1.45 | 0.80 | 147,716 |
| Central | 2.77 | 0.72 | 2.72 | 1.20 | 1.24 | 93,089 |
| Northwest | 2.77 | 0.72 | 2.72 | 1.20 | 1.24 | 93,089 |
| Midwest | 3.27 | 0.72 | 2.79 | 1.18 | 0.29 | 61,088 |
| West Coast | 9.48 | 1.13 | 2.19 | 0.39 | 0.44 | 36,988 |
| Region | 2.47 | 0.72 | 2.72 | 1.20 | 1.24 | 93,089 |
| Rocky | 9.42 | 1.13 | 2.45 | 1.54 | 0.24 | 72,316 |
| Midwest | 3.48 | 0.72 | 2.72 | 1.20 | 1.24 | 93,089 |
| Alaska | 2.17 | 0.66 | 0.99 | 2.03 | 0.36 | 93,089 |
| Pacific | 11.29 | 1.20 | 2.08 | 2.48 | 0.14 | 33,140 |

* Data is for year ending Sept. 30, 1960

Prepared by Ray & May

a landing aid proposed by Aviation Instruments Laboratories. Operating on microwave signals, the unit is now in the prototype and development stage. It is designed to provide television approach angles in the 6 to 20-degree radius believed most appropriate for instrument landing. Light jets have been made with the unit at Langley Field, Va., and at Farnborough where autorotation coupled descents were made down to 50 ft.

Another key item needed for effective IFR certification is a landing system for the V-107. The fifth aircraft scheduled for delivery shortly to New York Airways, was used in a series of tests at the Royal Canadian Air Force test installation near Ottawa. The tests showed that basic using a non-turbulent atmosphere.

These showed that the blades have self-adjusting tendencies down to 25 ft. Gallagher said, "For flying down to 25 ft. the blades were equipped with a servo-type compensated plastic shield, electrically heated for de-icing. To power the de-icing, the V-107's electrical power output must be doubled. This requires larger generators."

"We'd like to have this installed on the helicopter by this winter, but there's no provision for it yet in our economic forecast," Gallagher said.

The carrier's V-107 came equipped with a landing aid for the cockpit, perhaps not enough, said officials, a test aircraft not being available for using the system, pointing to the engine trouble again.

The helicopter also has VOR stability augmentation system, considered as crucial tool for IFR operation because it automatically provides aircraft stability.

Full Demonstration

New York Airways flight test program calls for full demonstration of IFR capabilities for the V-107 and its pilots. The aircraft will be flown at speeds down to 50 ft. in a non-turbulent wind at 115 ft. The tests will include a demonstration of 150 ft. The aircraft will be shown the self-kill feature and the engine augmentation makes imperative.

Gallagher said of IFR tests to date had been "under the hood," but that the program calls for flight under actual instrument conditions.

"We're shooting for full IFR certification, because that is the only way we can attain schedule availability," Gallagher said. "Anything less than complete instrument capability just won't do the job."

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Major U. S. Airports—Part 1

Walking Distance Main Airport Complaint

By Robert H. Cook

Washington—Recent 6,000-mile surveys of eight new airport hub systems by AVIATION WEEK & SPACE TECHNOLOGY indicates that the terminals share at least these two shortcomings above the needs of the passenger and how to meet them:

- A limitation with the negotiable "log-in" connection, which can be extended nearly without limit at gate positions as needed.

- An apparent conviction that most passengers are equally qualified for the New Frontier's 50-mile Elite Club.

The volume of passenger groups that transverse walking distances, which can pass even nonpassengers and walk growing out of the aircraft near-park problem, will almost certainly have some major implications to many of the gleaming new "aviation cities."

Distance Test

To test the magnitude of this problem, an accurate pedometer was used during the surveys, which covered San Francisco International, Oakland International, Los Angeles International, O'Hare International, New York International, Dallas International, Atlanta Municipal and Miami International Airports.

Dallas, defined from the ground up with the needs of the passenger first, provides a sharp, jolting contrast in the conclusion and completion typical of most large airports. Four ticket counters in wavy mobile mobile lounge, walking distance seldom exceeds

100 ft., and Dallas staff may be the only airport in the nation where a late passenger can check baggage and pocket, purchase insurance and make a departure all within 4 minutes.

This would certainly be impossible at any of the other airports surveyed, such as O'Hare, Midway Atlanta and Miami, where walking distances generally averaged 8 miles. To the skeptic in before connecting passenger or international arrival, that distance is often doubled as he charts a course through a heartbeating maze of concourse and flag-laden buildings.

The question then poses for the future: How far will the traveler have to walk as traffic volume grows and new gate positions are created? Last year, Federal Aviation Agency figures show that domestic traffic alone reached 39 million passengers and a total of nearly 100 million are expected by 1975. While many of the large cities such as New York will probably require additional airports, many others in the hub class may choose to add new gates or extend further their present gate systems to accommodate yet more passengers.

Ironically, the airline industry, which has built a separation for pampering the passenger, has also tried and survived the present gate design shortcomings, including the majority of passenger complaints.

As a case in point, the architects for O'Hare Field rapidly recommended adoption of a central terminal building with a mobile lounge or bus-type travel port to reduce the distance the passenger must walk to the aircraft. Dallas has been

getting well to the north. The idea, along with an alternate plan, using a system of separate mobile buildings similar to that of Los Angeles, was rejected by the carriers as grounds that neither design offered the necessary airport parking or operational office space.

Dallas' use of the mobile lounge is being watched with more than ordinary interest by other airport management, plagued with complaints over terminal walking distances. They believe the \$237,000-per-gate cost and contend the concept could not compete with the peak traffic volumes handled at the larger hubs. Their argument is that Dallas was built by the federal government with taxpayer money, as opposed to a company of airports which are being funded under aviation bonds, payable solely from airport income.

Other Solutions

Most observers feel these options have some validity, since Dallas' traffic volume may not reach a volume high enough to give the lounge concept a solid test for several years.

However, other airport management are working on other solutions to the walking distance problem.

San Francisco plans a 15-month extension using a 500-ft.-reaching mobile travel port to connect its present terminal building with a new 100-ft.-reaching mobile travel port under construction. Cost of the addition, manufactured by Stephen-Adams Mfg. Co., Austin, Tex., is estimated at nearly \$300,000. Denver is expected to adopt the moving sidewalk concept in the future. Dallas has been



First United Air Lines Boeing 727 Flies

First of 40 Boeing 727 three-jet transports ordered by United Air Lines takes off on its maiden flight of Boeing's Seattle, Wash., factory. Aircraft is powered by Pratt & Whitney JT3D-11 engines, which develop 14,000 lb. thrust each on takeoff. Cruise speed is 550-600 mph and gross weight is 152,000 lb. Deliveries are scheduled to begin the fall and United will put the aircraft into service in 1964.



First Two BAC 111s in Final Assembly

First two BAC Avantair Corp. BAC 111 four-pi transports are shown in advanced stages of final assembly at Vickers-Armstrongs production plant at Hatton, England. Both are scheduled to fly this summer. No. 1 aircraft is being operated by the company but carries BAC markings. Eight more BAC 111s, including the four for British International Airways, are under construction.

For a similar pattern for several years

Western Air Lines, at Los Angeles, has been using a fleet of three rubber-tired, electric "golf cart"-type vehicles to transport passengers to the 450-ft. tunnel connecting its terminal facilities with the departing airfield building. This service is free and may be adopted by several other carriers at Los Angeles.

Atlanta reports that it experimented for five months with a similar system, charging 25 cents per round trip between ticket counter and finger end. The project was dropped for lack of passenger acceptance.

Stephens-Nelson also has proposed some major airports to pursue either moving Adelanto or a new Canyon Center. Canyon suggested for O'Hare, which is about 10 miles north of Adelanto, could include passenger concourses, each of which would be connected or deconnected automatically to allow passengers to board from and exit a moving platform. Canyon would primarily be used to accommodate outside the terminal building complex, and would change the airport's look, he continues. About

Permit costs and construction problems are the two main reasons why the "spiritual" bus transportation provided at such places as Los Angeles and Bielefeld.

These values for Δm approach O'Wens'

However, several airport managers pointed out that it could be difficult to estimate the cost of such an expansion, as airport management points to the sensitive cost of the San Francisco installation as indicative of the millions of dollars in tax funding needed to equip its facilities.

large system. In addition, annual maintenance costs on the system were estimated at \$100,000.

the solution of the walking problem was by no means easy, despite the fact that the unions and management would hold frequent negotiations.

Management managers were unanimous in their support of the walking problem as an self-regulating operation, financed at least initially through several bond issues. Since they sit in the nature of a landlord, with the only available rental income

instances, in the neighborhood, it has been generally difficult to ensure that the birds are provided with a sufficient amount of high-quality food to provide an adequate return for their maintenance. In fact several have been developing long-term surplus profits. Considered in a moment, except in this pattern, it would be a reliable new technology introduced in a stable society with few fast

Majority of bond money approved by the voters for airport expansion has already been spent, or will be spent soon for such major items as runway extension, new terminal, and new parking garage.



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CFI CARBONBLAST® over the 300Z spectrum from 300 to 1000 nm. Example of CF spectra taken 10 kW at 1000 nm in 0.1% NO_2 at 1000 ppm CH_4 at 1000 ppm H_2 at 1000 ppm.

As many of these letters are dated 1810, they can be read with much the assistance of the *Correspondence*.

5

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AIRLINE OBSERVER

► Contract to develop an advanced instrument approach and landing system suitable for use by supersonic transports, replacing existing ILS units in the 1970 period, is expected to be awarded by Federal Aviation Agency before July. The option is to use radar techniques and operate at X-band or Ku-band, and will include provisions for independent ground-controlled monitoring of aircraft approach. Five bidders include Aerobus Instruments Laboratory, Bell Aerospace, Gulton Corp. and Learson Inc. Electronics

► American Society of Travel Agents is planning a strengthened attack aimed at the elimination of private charter units on international routes and group fares. The society is discussing legal means of abolishing charter and group fares, creation of a special Washington, D. C., public relations committee to handle the issues and a formal presentation to airline managers on the travel agent's importance to airline marketing development.

► Lufthansa Airlines has made its first paving run on a new Wiesbaden-Aachen-Cologne highway, which will begin as regular once-a-week service June 17. Reconstruction will continue, though, with 19 round-the-year 11-ft-wide sections, plus a six-km cargo section, will be used. Schedule is for Mayday flights to Cologne with return service on June 1.

► Special Air Transport Committee for National Defense has been reorganized by the Air Transport Assn. to improve effectiveness of the Civil Air Reserve Fleet, which consists of 142 fixed-base transport aircraft, about half of which are jets, on 38-airline tails. Committee consists of 10 top-management officials of U.S. scheduled airlines.

► State Dept. last week canceled its winning contract U. S. commercial interests flying over Cuba. Withdrawal of the winning, road late November following the missile crisis, was based "on the fact that foreign airlines have overflew Cuba without incident during the past several months," and any risk to the safety of U.S. operations is "remote."

► Aeroflot has inaugurated regular nonstop service between Moscow and Dusseldorf with B-747-100B/100B. Schedule time for the weekly Moscow flights on the 1,880-mi. run is 5 hr. The Moscow-Dusseldorf service is Aeroflot's 16th transcontinental route.

► Pan American World Airways' order of eight Boeing 707-300C turbofan cargo aircraft can lead to the industry's first nonstop transatlantic in high-volume cargo shipping. But until the airline received 10,000 domestic and foreign aircraft concessions, the effect the new turbines will have on delivery times and lower cargo rates, Pan American now has three 727Cs and will get the balance by next May. It is concentrating marketing efforts on the disposal of specific commodity items. Sufficient volume could lower rates by 35%, the airline estimates.

► Labor Dept. achieved its first success in the voluntary arbitration of labor disputes last week when Pan American signed agreements with the Flight Engineers International Assn. and the United Plant Guard Workers of America. These two agreements stated that neither union will strike Pan American, and will remain subordinate to each other, although no memorandum had been signed. Agreement with FFEA does not cover crew supplement issues, which have already been settled. Labor Dept. has already offered the same plan to other unions and is approaching other unions. Evident prospect is Trans World Airlines, whose pilots have been pressing for a reduction in monthly flight times.

► Braniff Air Lines has made an abrupt departure from standard airline advertising practices by emphasizing safety, and promoting airline services generally other than Braniff specifically. First full-page to reflect the revised advertising concept reads: "Don't Drive—It's SAFER to FLY, and Often Cheaper Than Your Scheduled Flight." Three other local airlines have indicated they will adopt similar advertising, because an industry-wide action has been initiated by Am. of Local Transport Airlines.

SHORTLINES

► Aeroflot has increased its total number of scheduled flights to about 1,200 daily—a annual increase for the Soviet airline monopoly. Over 60% of the flights are made with jet or turboprop aircraft.

► British Overseas Airways Corp. has reported an 18% increase in passenger traffic on the New York-Buenos Aires route in the two-month period ended Mar. 31, compared with the same two months last year.

► Federal Aviation Agency has approved lower landing fees for Pan American World Airways at Baltimore, Philadelphia, Detroit, Chicago and San Francisco. With a Spruce flight director providing pilots and controllers, the aircraft are permitted to land on the basis of a runway visual range of 2,000 ft.

► Flying Tiger Line showed a 38% increase in air freight revenues in April, compared with the same month last year. For the first four months of 1963, freight revenues totaled \$5.5 million, a 55% increase over last year.

► Iberia Air Lines of Spain has opened a new direct route between London and Valencia.

► National Airlines has flown more than one billion revenue passenger miles on the northern transcontinental route since its inception in June, 1961 (ENR Mar. 5, p. 42). The carrier now operates six daily Douglas DC-8 round-trip flights on the coast-to-coast route.

► Sikh Corp. last week received an \$8.6-million contract from Military Air Transport Service to operate domestic air services within the U.S.

► Trans World Airlines continued to show marked improvement in traffic during May (ENR May 27, p. 40). During May, revenue passenger miles increased 18.3% over the previous month. International traffic rose 24.2% and domestic traffic climbed 18% during May.

► Trans World Airlines will re-enter the first all-air transcontinental passenger service, inaugurated in October, 1953, to mark the 10th anniversary of the Trans World Express. The airline will use a Boeing 707-300B, and will be named First Trans World Transport on June 25-26. The occasion is the 25th anniversary of the Civil Aeronautics Act of 1938, which was later amended as the Federal Aviation Act of 1958.



Moving 45 tons at 550 miles per hour is routine for today's mighty jet transports. These transoceanic Boeing, Douglas, and Lockheed sky freighters are powered by Pratt & Whitney Aircraft's modern JT3D turbofan engines. Pratt & Whitney Aircraft provides design and manufacturing leadership in power for many applications, in and out of this world.

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A



STEERED TO THE TASK! The turbine-powered "Seasprite" dashes at 140 knots to the rescue. For this vital task, the new Navy helicopter must be reliable in every part. Critical importance is the main transmission support—the bearing beneath the rotor, connecting the power plant to the fuselage. The aircraft

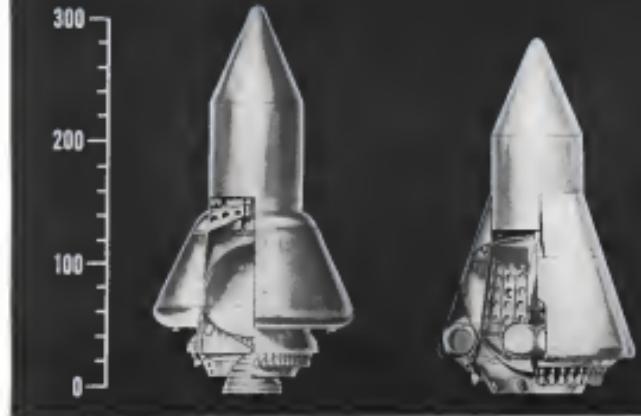
is literally lifted by this frame. The manufacturers, Kansas Aircraft, had to find a steel with a high strength-to-weight ratio that would keep the design compact and could stand up indefinitely under all flight loading conditions. And it had to be reliable.

Timken aircraft quality steel tubes worked best. "They were

selected over other types," reports Konz, "because their uniformity adds reliability to the design." The result: Several spares were never needed, machine costs were cut down, rejects were practically eliminated.

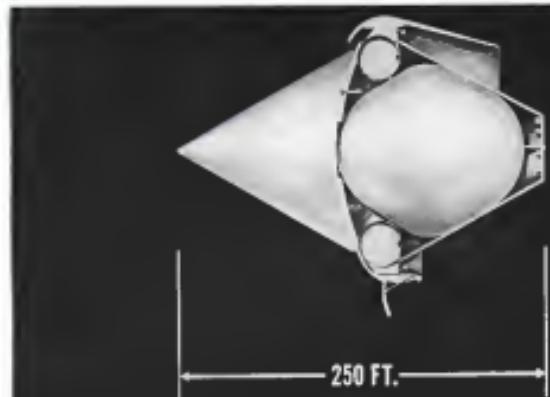
Uniform high quality is a trademark of the Timken Company—has been for all the 45 years we've been in the steel

Timken steel tubing and graphite tool steel are available from steel service centers listed in *4800*. Check the Timken steel representative nearest to you.



Stage Recovery Featured in Nova Class 3 Vehicles

General Dynamics Aerospace and Martin Marietta Class 3 Nova vehicle designs recently selected by National Aeronautics and Space Administration (NASA) from 50 p-14) include GEVA fully recoverable. Helapse design (upper left) with booster engine which re-enters close to launch site after one orbit. GEVA vehicle on right, known as Nova, is a single-stage recoverable design. Martin vehicle (bottom), designated Kneecap, is single-stage and uses the hydrogen tank to form a nozzle plug and the thermal ring for an oxygen tank. Rockets are enclosed in the air duct, which has adjustable nozzles around circumference of the vehicle at the base of the central finning. Flying booms payload and stress at an inlet spike during the re-acquisition boost phase. Flaps (not shown) extended at bottom) extend after payload separation to start booster stage reentry.



Refinements for Advanced Rocket Motors

By Irving Stone

SANMARC, Calif.—Drags and operational refinements to meet advanced technology requirements for both liquid and solid propellant rocket motors are being investigated by United Technologies Corp.'s United Technology Centers Section.

UTC currently is pushing development work for the *T-120*, an 115-in-dia., solid-propellant strap-on motor for the *Titan* 3 booster.

Advanced propulsion studies include:

- Hybrid motors.
- Adhesive thrust chambers.
- Metal adhesives.
- Thrusting jetpacks.
- Nozzle design for large solid motors.

The hybrid technique is a relatively new approach for obtaining chemical propulsion performance which cannot be achieved practically with either all solid or liquid systems. Another basic idea under investigation is the solid hybrid in the bonding and operational regimes.

A hybrid engine can be literally defined as a non homogeneous propellant which uses a high-solid or gaseous phase. UTC has demonstrated the principle of the gas-solid combustion by using gaseous oxygen and propane (polymerized ethylene) in the solid fuel.

The hybrid model uses a charge of propane ignited by a sparkplug to initiate combustion, which continues as long as the gaseous oxygen is fed. Burning rate is controlled by the rate of oxygen flow.

The hybrid model uses a charge of propane ignited by a sparkplug to initiate combustion, which continues as long as the gaseous oxygen is fed. Burning rate is controlled by the rate of oxygen flow.

The standard hybrid uses a solid fuel and a liquid oxidizer. A "preheat hybrid," also feasible, uses a solid no-drossel liquid fuel.

Principal advantage of the standard hybrid is the ability to use either existing or advanced regimens without concern for chemical compatibility. Advanced (novel) chemicals usually are used to attain substantially higher performance, but these chemicals generally are difficult to handle, and compatibility with other parts of the propellant system usually presents a problem.

Another basic advantage of the standard hybrid is the capability for a rapid start/stop program with either an as-modulated operation, or both, UTC research says.

Hybrid's Advantage

Specific advantage seen for the hybrid over a solid propellant system is that the former provides higher energy than the solid because of the igniters which can be used. Specific impulse established thus far for acceptably solid propellants has not been extremely high and, in addition, solid fuel thrust control cannot be easily accomplished with a solid motor.

High-energy requirements always will be important parameters since the higher the energy of the propellant, the higher the propellant system efficiency. It is difficult to calculate the energy content in terms of propellant weight, for an aerospace system permits a reduction in booster weight of 200 to 300 lb.

Compared with all-liquid systems,

the hybrid is about half as complex in design and provides a higher-density system in the same volume. UTC agrees in Space technology involves coping with temperatures of -300°F and as high as 2000°F (depending upon insulation factors). This is a difficult condition which is not compatible with most hybrids. The hybrid employs only one fuel, compared with two in the all-liquid system, and therefore has less chemical incompatibility.

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Possible Contaminants

Essentially, any combination of fuels and oxidizers is feasible in the hybrid. Almost any combination of elements in the periodic table probably can be used—with some still in early planning—UTC says.

In the standard hybrid, the liquid-to-solid ratio has not been less than one-half to 1 to 1. Now, the proportion of liquid oxidizer to solid propellant is about 1 to 1 to 3 to 1.

UTC has conducted considerable laboratory-scale work with hybrids. The company has fixed model engines developing an thrust of 42,000 lb. thrust for about 25 sec. Propellants have been



MULTIPLE DIFFUSION COMBUSTION process in a hybrid motor is shown in diagram above, which shows how active combustion zone is separated from solidified residue with heat flow paths both inward and outward from the zone. Injection liquid enters from one end of the solid phase cone leaving the nozzle.



MODEL ABOVE HAS BEEN USED to demonstrate hybrid rocket motor operation. Solid phase is hollow-core cylinder of propellant. Oxidizer is gaseous oxygen.

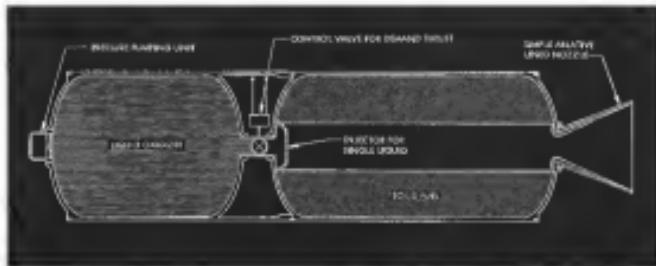
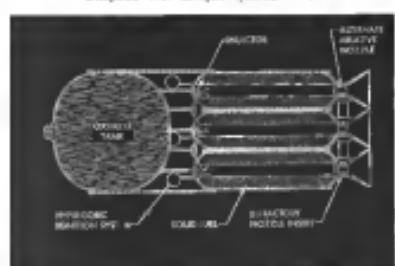
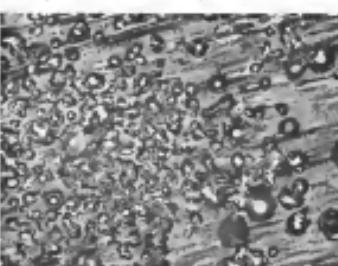


DIAGRAM SHOWS TYPICAL HYBRID except for a mono-nozzle hybrid propulsion unit. Solid phase contains no oxidizer and will not support combustion. Liquid oxidizer would be hypergolic with solid phase and burning rate is determined by oxidizer flow rate. Unit would have small and short combustion capabilities.



CLUSTER OF MULTIPLE FUEL CHARGES for large rocket motor development is shown in diagram above. Left: Right magnified 100 times is particle of deionized powder propellant additive for both liquid and solid rocket systems. Powder shown is fine, not as a shell. Metal constituents to energy content of fuels and boost specific impulse.





Problem: duplicate this environment...



...and then maintain it out here

Before America's first manned space station goes into orbit, a whole new generation of problems will have to be met and solved.

To keep the crew in good health, for instance, we'll have to maintain their Earthlike environment for months or years. We'll have to devise a supply system to get food, air, and all the other necessities up to them regularly. We'll have to keep all their equipment in operating condition. We'll have to be able to work on the outside as well as the inside of this station. We'll have to develop vehicles and techniques for shuttling personnel to and from the station, as well as for in-space rescue.

Lockheed-California foresaw the scope of these problems five years ago, and brought together a team of scientists and engineers to specialize in man-in-space. The SpaceCraft Organization has developed a high degree of expertise in all aspects of space station design. They have conducted extensive studies of techniques and vehicle designs for supply, maintenance, rescue and logistics in space. Today they stand ready to undertake the many vital tasks upcoming in this challenging new age of man-in-space.

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Meeting the need for reduced size, weight and resistance of ground-supported multi-conductor cables, the new **MIL-C-13777D** specification calls for a cable that maintains high heat reliability in every area of the world. Cables have withstand severe mechanical abuse, resist oil, ozone and weathering, and remain flexible over a temperature range from -40 to 180°F.

Included as primary insulation in this new spec are DuPont Teflon® resins—both TFE and FEP. Their contribution to 13777 cables stem directly from their unique properties, such as high heat resistance (TFE withstands continuous use at 300°F, FEP at 400°F). This property in itself permits a sizable reduction of cable diameter and weight for equivalent current-carrying capacities. Smaller cable dia results in combination with very low coefficient of friction between the adjacent wires, assure good cable reliability. This results in much greater cable flexibility at temperatures below -45°F. Terminations, too, are more reliable, because the insulation resists heat damage from soldering iron contact. Because Teflon resins are

completely inert to virtually all chemicals, they eliminate problems of acid and solvent attack. And the new resins are designed for use as, at 180°F, resins do not support combustion.

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Hybrid Motor Operation

Inspiration of a hybrid engine is required to handle only one fuel oxidant, that is, perform a single function. But the injector is a liquid-propellant engine. The hybrid engine requires introducing the oxidant in a highly atomized form, which is easily reported.

One place of the hybrid-propellant combination has the true general configuration as a cold-propellant motor, but it contains no oxidant or, therefore, self-oxidation combustion.

These factors allow self- and thermal-oxidation capabilities because the burning rate is determined by the oxidant flow rate.

Fundamental basis of hybrid combustion is that the liquid does not contact the surface of the solid phase since burning has begun. Combustion of liquid propellants proceeds by thermal oxidation, decomposition and chemical reaction.

Combustion is started by the ignition of liquid oxidant and droplet flow to the cold surface of the solid fuel. If the reaction is exothermic, a cyclic auto-catalytic action is started, guaranteeing that the continued decomposition of the solid fuel.

After initial burning, the reaction processes oxidizer and an auto-combustion zone is established. This zone is separated from the cold surface by at least 1700°.

Some of the heat from this combustion zone is directed to the surface of the solid propellant. The cause separation and decomposition to generate additional solid-propellant material, which continues to support combustion.

Heat also flows from the opposite side of the combustion zone to convert the liquid oxidant into a gaseous form which diffuses into the combustion zone to sustain its reaction. The rate of this reaction is determined by the flow of oxidant directed to the ignition.

composed of rubber (butyl/epoxy) and aluminum powder in the fuel grain. Nitrogen tetroxide is oxidant. Nitrogen tetroxide is highly toxic with very stabilized solid propellant.

Progress in a higher thrust engine is not reflected until an application defines a requirement. UTE is primarily interested in提高 efficiency and obtaining better fuel utilization as a step toward reducing state-of-the-art for hybrids to practical engines. Studies are being directed toward maximizing propellant thrust and high combustion efficiency in a uniform and controllable manner.

Unique Conditions

UTE's research with hybrids has shown that the burning reaction is insensitive to chamber pressure—a condition unique in chemical-propellant engines. Also, hybrids exhibit a very low sensitivity to environmental temperature.

Hybrids appear promising for upper-stage engines and for reusable vehicles which require long-term propellant storability and reusability, isolated thrust. Considerable potential is indicated for some of the more sophisticated audience applications.

Hybrids are not being used now in operational configurations primarily because they are competitive with already developed propulsion techniques. No requirement has been defined to date which could justify use of one of these extended techniques.

Researcher feel that more experimental background is necessary for straight forward hybrid design to pursue ad-

In a related area of engine applications, UTE anticipates highly promising applications for hybrid-cooled, liquid-propellant rocket engine throat chambers in upper stages. The company believes these can meet requirements for low and average thrust values for durations up to 20 sec., an both steady-state and off cycles.

Aluminum-cooled chamber have already been selected for application to the funding engine (18,000-lb-thrust chemical and hybrid engine (30,000-lb-thrust class) of the Laser Guidance Missile, the venture (30,000-lb-thrust class) of Titan 3, and the Atlas service module engine (23,000-lb-thrust class).

Aluminum-cooled throat chamber technology today has topped only a small portion of developmental potential, UTE researchers say. Current techology has utilized only low-expansion chamber pretenses (about 160 to 200 μ in), using available stable propellants to provide specific impulse of about 370 sec under various loads. Nominal expansion ratio with these applications is about 40 to 1.

The ablative throat chamber is based by utilization of some of its own waste heat for gas generation. For this reason, the chamber is hybrid-cooled, compared with a regeneratively cooled unit, which has an indefinite operating life. However, the ablative throat chamber shows promise advantages in the high-temperature combustion chamber.

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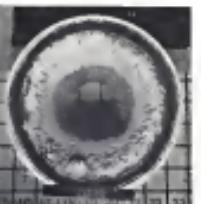
•

Ablative low-pressure hybrid throat chamber can induce significant heat to the propellant supply system as a result of cooling requirements.

• No propellant shutdown at all since it is required for the pressurized engine.

• Ablative chamber is more rugged, would be less susceptible to physical damage from atmospheric penetration.

• Fission debris deep space shield.



EROSION of the throat chamber shows an 80% weight reduction in the new of the development and. Mass of hybrid motor is used a hybrid motor which has cooled in the nozzle and. Coated technology and chamber pressure from 100 to 200 μ in.



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DISCRETE REPRESENTATION BY MATCHED EQUIVALENTS



be less pronounced for the ablate chamber.

While ablative chamber might apply to requirements up to 40,000 to 10,000 lb. thrust in upper system, UTC uses the radioisotope engine which shows a distinct performance advantage over the pressurized design about the thrust level.

Use of the radioisotope would resolve operation with high chamber pressures. There would eliminate the possibility of an ablative thrust because of the high rate of erosion in the ablative material under such pressures. Improved isolation would be required for this mode of use.

Damge Susceptibility

One problem with the ablative chamber is that it is much more susceptible to damage from a poorly designed or defective probe than a regeneratively cooled probe. The probe's control must be mounted on the fabrication of options for ablative chamber, since greater deflections might produce probe repetition patterns and "cold" conduct stems which might cause excessive erosion and burn-through, UTC designers note. Rapid thermal changes could affect thrust level in a constant-pressure fuel system and degrate engine performance.

Stable operation with the ablative chamber using present-day materials seems operation to an upper level of about 300 psi chamber pressure for general application. This stems from the fact that ablative rate is a function of the pressure.

Current applications for the ablative chamber are in the space program as distinguished from booster applications. However, ablative chambers are believed applicable to commercial markets which might use a chamber pressure as high as 1,000 psi for a very short duration time.

Material used for ablative chamber generally falls into a single category—knit-welded wire cloth bound with epoxy resin. Various firms use different approaches in cloth makeup, lay-up application and method of impregnation.

Nozzle Construction

Typical construction of an ablative nozzle for upper stage is with a chamber pressure of 200 psi and a nozzle exit pressure of 10 psi, resulting in a throat thickness of about 1 to 1½ in. with the open-faced wire cloth material decreasing in thickness toward the nozzle exit plane.

The ablative material would be surrounded by an insulation (heat flux) of porous, low-density, material (insulation) such as asbestos about 1 to 2 in. thick. For structural strength, the chamber would use a ½ in.-thick, epoxy-bound, glass-fiber-wrap in a helix

RONICS

EN-VI-RONICS (en-vee-roh-niks) n. New space age concept from AAF. Art of total-system environment control—developed, produced and installed through a single corporate source and engineer-management team. For example, the integral automatic system making each Minuteman missile and launch-control center environmentally self-supporting.

AAF Envirocells is not synonymous with air-conditioning; systems include ultra-high reliability features, shock-proof configurations, radio-interference suppression, filtering efficiency, and explosion-proof operation provisions that go beyond any conventional air-conditioning or air-handling component. In fact, no conventional concept restrictions apply to AAF Envirocells.

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AAF Envirostar is founded on a unique range of products and services that can meet nearly any environmental planning in all phases of environmental control, civilian and military. It's AAF Defense Group's D-164A and environmental test group. Working in close cooperation with the Defense Products Group, America's Air Filter Co., Inc., 2218 N. Price Road, St. Louis, Mo. 63118.



Developed by the engineers who control Minuteman's environment control system. With contract for Wing I accomplished, AAF and its subcontractors are now resuming installation on Wing II, Ellsworth AFB, S.D.



Vertical assault at 200 mph

Sikorsky's new CH-53A transport helicopter will be big, fast, and tough. It will provide the U.S. Marine Corps with its first all-weather, all-weather helicopter for vertical assault missions.

The powerful CH-53A will speed 30 troops or 8,000 pounds of cargo 115 miles at 179 mph—and return without refueling. On short missions it will transport 64 men or 18,000 pounds. It will carry a Pershing missile, 35 mm howitzer, or three-quarter-ton truck. It will operate

from any terrain and offer a watertight hull for emergency flotation. Under light-loaded conditions, top speed will exceed 200 mph.

An advanced auto-loading cargo system will permit one man to load a tonne minute. Portuguese external cargo can be picked up in flight without a ground crew.

The CH-53A is based on the proven technology of Sikorsky's twin-turboshaft S-65 Skycrane. First flight is scheduled for 1964.

Sikorsky Aircraft

SYNTHETIC HONEYCOMB



pattern. A thinner sheet of aluminum could be substituted.

It is feasible to use an ablative thrust chamber incorporating aluminum casting on the expansion skirt. This can be achieved by use of a relatively inert metal from approximately the 5 to 1 area of point out to the nozzle exit plane. Gas injection ports and ducts in this location will have decreased to a value sufficiently low so that heat transfer rate is within the limits of available refractory metals.

Thrust chamber for a 10,000-lb-thrust ablative thrust chamber operating with a pressure of about 100 to 110 psia might be about 6 or 7 in. Chamber length could be approximately 3 to 6 ft and nozzle exit plane about 4 to 5 ft as diameter.

Plastic feasibility

Consideration of the ablative nozzle for solid-propellant rocket motors in the 120-, 150- and 200-lb-thrust areas will indicate an extremely favorable result for cylindrical propellant. A nozzle can be launched in this direction because the stability of large graphite thrust has been difficult to analyze, and two of these thrusts have been successful in large-scale tests, UTC says.

Postflight inspection of a 24-in-dia. thrust with graphite liner revealed cracks which indicate low modulus of elasticity.

Another factor which points the way for the use of the ablative materials in large nozzle is the minimized effect of erosion in these big sizes. The most negative is to minimize the percentage change in the nozzle throat area.

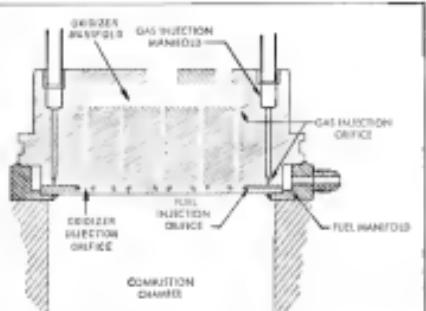
In small motors, a small amount of added substrate (cement) of the throat will introduce a significant change in throat area, minimizing the change in pressure and expansion ratio. In contrast, small throat changes in large nozzles create no significant effect.

Thus, in a small nozzle, erosion of the throat from 500-lb-thr to 700-lb-thr will result in a throat-area increase of about 90%. However, a 2-in change in throat diameter in a 3-in-throat throat, a size which might be used with the large solid motors now under development (PAW Feb. 11, p. 300) would result in only a 10% increase in throat area.

UTC believes that a graphite thrust made for the large solid-propellant motor now under development could be designed for a weight-to-thrust ratio of 1.0. This compares with a ratio of 1.25 for the nozzles and throat which are proposed for these motors. But the fact is that a graphite-cloth or carbon-cloth thrust will be a simpler development. However, there is no indication that erosion resistance of the graphite thrust will be equal to the cloth buildup.

For this reason, thrust design for the

AVIATION WEEK & SPACE TECHNOLOGY, June 12, 1963



PROPELLANT INJECTOR DETAILS during low-gas injection is used to produce homogeneous gas/liquid mixture in fast burning regime for throttling. Throttling ratio of 10:1 has been demonstrated with a 6,000-lb-thrust engine.

largest solid rocket motors will involve a compromise between size of development, fabrication and availability versus erosion resistance.

The cloth would be obtained by subjecting an organic cloth to a chlorinating process. Exposure for longer periods of time at higher temperatures than required for the carbon cloth would produce a graphite cloth. After impregnation with phenolic resin, the cloth would be laminated to provide the required configuration.

Normally, the use of graphite cloth or carbon cloth would be restricted to areas of high heat flux in the throat region. Downstream of the throat, the cloth would be removed. But final or other methods of loading silica in a matrix of phenolic could be used.

Throat buildup material might be a silicophenolic or carbon. In the 120-lb-thrust motor, thickness of the throat liner might be about 3 in and buildup thickness about 1 in. Orlon fabric of the nozzle probably could be strengthened by a glass-fiber epoxy winding.

Resinol breasle

With this type of construction, a 120-lb-thrust motor of solid propellant would have a total weight of an ounce or about 3 in.

In other propulsion industry developments, use of metal additives to increase the energy content of liquid fuels is getting increased attention.

Experiments in this field of research is not as advanced as in solid fuels with metal constituents.

Metal additives for fuel can respond to have high heat energy and low reac-

tional weight in the form of volatile products, since specific impulse is directly proportional to the square root of the flame temperature divided by the molecular weight. In addition to increasing specific impulse of the propellant system, metal additives also indicate the overall density of the system. This is an advantage in solid-rocket motors where high-energy fuels can be contained in a small package, UTC maintains.

Despite of the metal as metal derivative, such as a hydride, usually a greater than the density of the liquid fuel. Therefore some method must be found to suspend the metal or derivative in the liquid.

Particular use of the additive results in the 5- to 20-mass range. Small particle size is desirable to improve the propellant performance, but considering the fact the problem of maintaining proper density. Usually, a single-size particle in the 5- to 20-mass range is used. If particle size is too large, some mass is lost in the propellant because of the large volume of metal additive required to provide a desired weight of additive. Also, in small-size particles the presence of voids causes if accelerated, affecting combustion efficiency.

In the pyrolytic process, a gelating agent usually is added to the fuel first, followed by the addition of the metal or derivative to create a thermoplastic gel.

Application of pressure, in a pressure-fed system, will cause the



How many airplanes are in this picture?

We see at least eighteen.

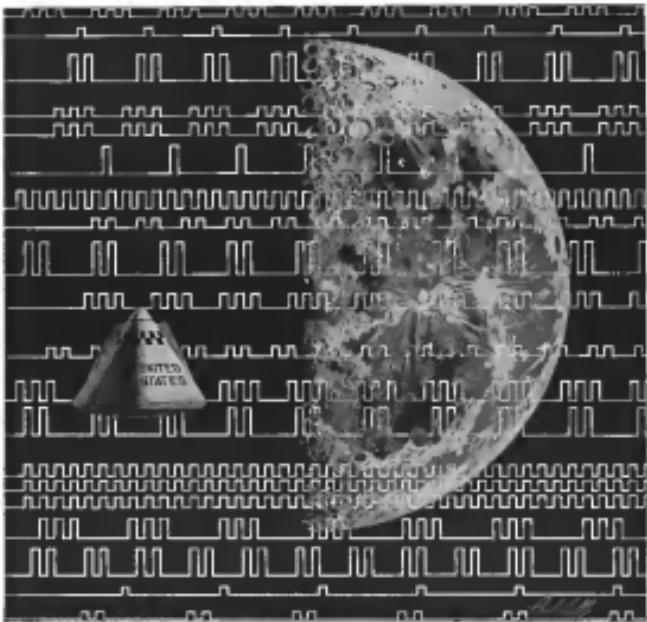
We designed the Northrop F-5 to accommodate at least eighteen different combinations of air-to-air missiles, air-to-ground missiles, bombs, rockets, napalm, and extra fuel tanks.

Seven external stations on the F-5 will carry up to 6,500 pounds of payload and extra fuel, yet the F-5 weighs only 8,100 pounds itself, unfueled.

In clean configuration, the F-5 has a sea level rate of climb of 30,000 feet per minute, and can fly supersonic at altitudes up to 50,000 feet. In ferry configuration, maximum range is a healthy 1,650 nautical miles.

Yet with all this performance, the twin-jet F-5 is an extremely practical aircraft. It can land and take off from the sod fields and unimproved runways of forward area bases. In operational squadrons, it will require considerably less man-hours of aircraft maintenance per flight hour than other supersonic fighters.

The F-5 can do many jobs, and do them well. **NORTHROP F-5**



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Example: APOLLO's PCM Telemetry Systems

Radiation Incorporated offers the most advanced capability in PCM command, control and telemetry for aerospace. Because of Radiation's successful participation experience, the company was selected to design an entire space-based telemetry system for the Apollo Lunar Excursion Module (LEM) on the first Moon landing.

The PCM system requirements, Antennae in flight and check analysis permitting no redundancy by the contractors, flight use of replaceable modules, respectively weight 90 lbs., gives approximately one cut circuit, channels are parallel, one serial digital input, high level D-40 and low level E-40 are receiving inputs. Highly reliable qualified components are used throughout, the system enabling highest MTBF to be achieved in mission performance.

Also, two 30 rock ground information handling systems will serve as primary data reduction centers. One will handle data from the capsule and the other from Sputnik's second stage booster.

Ground/Marspace Information Handling Systems—Apogee, Chakradar, RF Systems—Monitoring



RADIATION
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composite fuel which has rheotropic properties, to flow.

Flow rates in the order of 40 sec of logistic are possible with the use of metals or metal-doped additives, currently available. These include, in the general order of their contribution to performance, aluminum, aluminum hydride, boronium, and boronium hydride.

Boronium, a highly reactive metal, may have limited applicability as an additive for both liquid and solid fuels. Although boronium weighs less than boron and aluminum, this advantage does not offset the higher heat-release characteristics of the latter two metals, UTC engineers say.

Handling Methods

Techniques used with additives are hydrazine, cryogenic/diethylamine, and monomethylhydrazine. Oxidants selected may include nitro per nitroso, mixed oxides of nitrogen, oxygen difluoride and hydrogen peroxide.

Logon benefit obtained by hydrazine metals or derivatives in a liquid oxygen fuel, such as hydrazine, mainly is derived with an oxygen-containing oxidant rather than hydrazine, such as hydrazine, UTC researchers believe.

Problems associated with the use of metal additives in liquids are related to impurity damage, since fuels with metal additives are not necessarily inert. Corrosion is not directly proportional to the metal type. Corrosion efficiency may also reflect, because metals do not exhibit as high a dissolution efficiency in normal liquids.

Storage Life

Long term stability also must be offered. If the gel separates because of variability, the metal particles will tend to settle, leaving the liquid fuel at the top. This would result in clogging of the impeller. Also, this separation could cause a condition of variable thrust, UTC says.

In comparison, metal additives in solid propellants cause no impurity difficulties, and the problem of degraded combustion efficiency is not as serious as with liquids incorporating solid additives.

Increase in specific impulse obtainable with metal additives as solid granules are similar to those gained from liquids combined with additives.

Importance of improved thrusting techniques is emphasized by the requirement for variable thrust in the landing engine of the Lunar Excursion Module, as well as in the backup engine for that vehicle (ANW, June 1, p. 30).

Delayed ignition associated with fueling at the injection is velocity of the rocket propellant. This problem

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ABLATIVE THRUST CHAMBER prototype. Port at arrowhead with nozzle exit cone has had a quarter inch cut from propellant injector exit; to close passage is under. Slightly eroded, blackened thrust area is indicated by arrow. Ablative material protects casting when by softening nature of its own nose cuts the hot gas stream.

flow, which occurs with a fixed-area injector, may be eliminated with a variable-area injector. However, perhaps some may suffer as a result of poor atomization and mixing of the propellant. Also, the vernierable design is subject to mechanical complexities, as with a nozzle area ratio.

Another concept of throttling uses a fixed-area injector and gas gun injection to maintain the impetus column, while reducing the rate of propellant flow. This approach does not involve rate changes, except for the initial, extremely high combustion efficiency, according to UTC.

Propellant-fuel mixture's premixing—no gas-bubbles—should be used for the nozzle process. A nozzle gas preheat would not be used because that would necessitate carrying a separate gas supply. Also the gas in there with the mixture would be used because the mass of propellant fuel is small in comparison with the propellant mass.

Additional injection of the gas would be limited to the fuel nozzle, because introduction of the nozzle gas into the oxidizer nozzle could create a combustion kernel which might damage the nozzle.

Throttling ratios of 35 to 1 have been demonstrated with switches at the injector face in a 6,500-lb thrust engine, according to UTC. Cross sections, upstream of the injector, could easily give a 100:1 ratio, UTC says.

Another approach to throttling is the use of droplets for both the oxidizer and fuel. The two mix and heat over the full throttling range. At full thrust, all droplets would be mixed, with gradual fall closing of the valves on use

A special work group formed by the Interagency Chemical Rocket Propellants Group is charged with the task of composed of personnel from ARPA, Air Force, Army, Navy, John Hargan, Applied Physics Laboratory's Chemical Propulsion Information Agency and National Aeronautics and Space Administration has convened studies and the scientific priorities for data on combustion instability. This data will be used in a general analysis of the ramifications of this problem.

Two general forms of combustion instability in liquid-propellant engines are low-frequency oscillations, the basis of chugging, with amplitude in the range of 10% and high-frequency ("stuttering") oscillations, which can involve pressure fluctuations of the order of 3,000 psi. The latter form frequently involves destructive effects, according to UTC.

Low-frequency instability usually results from a coupling between the propellant feed system and pressure oscillations in the combustion chamber. This results can be eliminated through increasing the pressure drop across the injector face by introducing pressure losses in the propellant system or by redesigning the injector.

Another technique for solving this instability is to reduce the propellant injection rate and the propellant jet upstream of the injector face.

High-frequency instabilities, an extremely complex phenomenon, is not well understood. A general conclusion is that the larger the combustion chamber, the more susceptible to instabilities, and there is no theory which adequately defines the mechanism, UTC says.



Agene D Voltage Regulator Shown

Bottom-left, bottom, front; current voltage regulator developed by ITT for use with Snap 30A on Agene D spaceflight consists of (1) filter box to decouple power lines from regulator, (2) shunt regulator box containing sensing and servo circuit and (3) master power. Plates are mounted directly from the regulator box.

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We want data on ICBM re-entry, here in the Indian Ocean where they impact... we need fully-instrumented missile tracking stations that are "floating islands" ... able to operate hundreds of miles from land... to serve as the final link in the Atlantic Missile Range tracking network.

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In June, 1961, the U.S. Air Force Missile Test Center issued a contract for which there was no precedent. It called for the de-mobilizing of two wartime trooperships—and their conversion into ongoing tracking stations.

These ARIS (Advanced Range Instrumentation Ship) stations were to monitor the re-entry phase of missions on the Atlantic Missile Range. They would operate as far as 10,000 miles from Cape Canaveral... as near as three miles to "splash point."

please turn page

In 21 months, the answer



In record-setting time, 21 months after go-ahead, the ARIS industry team has delivered the U.S. Air Force Ship General H. H. Arnold—the most complete missile tracking facility ever put to sea. Soon it will be joined by a second ARIS ship.

Time Was Short. To accomplish the job as quickly as possible, the ARIS team employed new techniques. Procurement had been pre-planned. Six weeks after contract signing, the first ship was in dry dock. "Roadmapping" the project for PERT control, computers had already reduced hundreds of thousands of calculations to minutes. Aspiral teletype link provided immediate inter-contraction communications. While the ship's bulkheads were being remodeled, full-size equipment mock-ups were wired in advance to speed installation of actual instruments. Guided radar mast supports were pre-assembly machined aboard ship. On-site shore tests of systems reduced trouble shooting after installation.

A Floating Island. The Arnold embodies the latest in integrated instrumentation, inertial navigation gear, data processing, and communications. Scientists aboard will be able to gauge the accuracies of missile guidance techniques... compute aiming corrections during reentry... determine whether warheads can be detected from decoys and "junk" out through space with them... how to detect... how not to be detected. They can collect 25 to 40 million bits of data in a two-minute ICBM pass.

The ARIS radar system—six radars integrated as one—is the largest, most powerful ever put to sea. Associated instrumentation will permit terminal and mid-course trajectory measurements... meteorological measurements... 24-hour laser probe monitoring... and much more. The Arnold is the result of a dual combination of engineering skills... broad capabilities in system integration... and positive industry management. The ship stands forth as a worthy achievement of the Air Force and the

ARIS team. It will prove its worth to the nation as well in the years ahead.

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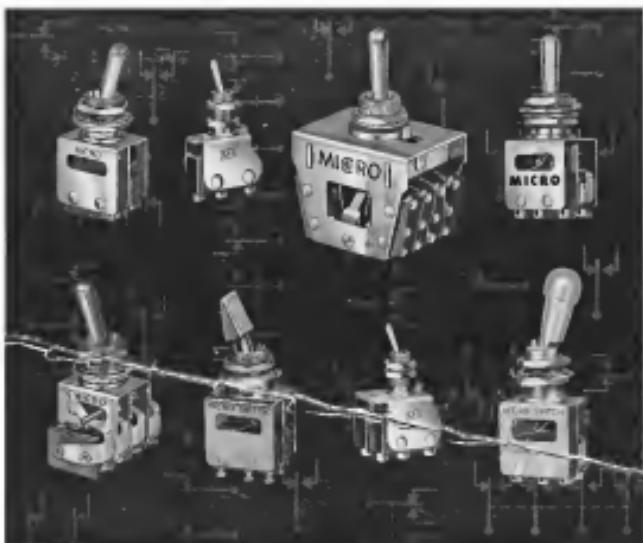
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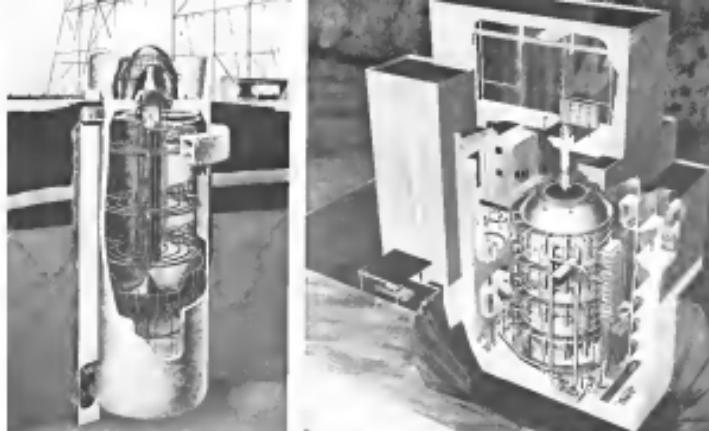
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FACILITIES FOR AEROSPACE RESEARCH at U.S. Army Arnold Engineering Development Center, Tullahoma, Tenn., will be expanded in 1967-68. Programs now under way. Among the facilities to be built are Rocket Test Cell 14, above left, which will accommodate vertical test caskets of up to 300,000 lb. thrust at simulated altitudes of up to 100,000 ft. With modification, it could accommodate 1.5 million-lb. thrust engines. Also, right, is Environmental Chamber Mark 1, which will be able to simulate altitudes of up to 100,000 ft. Chamber, which will be 16 ft. high and 17 ft. in dia, will accommodate full-scale aircraft.

Arnold Research Center Expansion Under Way



HYPERSPEED RAILROAD, now undergoing checkout, is 1,000-ft.-long, 19 ft.-dia. tube in which vehicles of up to 50 mi. per hr. can be accelerated. Effects of extreme temperatures and pressures and their influence on aerospace design as well as plasma shield and heat insulation problems will be studied. Locomotive section, at right, will run at 20,000 fpm initially and later at 35,000 fpm.

AFOSR Awards

At Four Office of Scientific Research awards grants and contracts totaling approximately \$3.6 million to universities and research firms in the United States and Europe.

Grants

University of Illinois, Urbana-Champaign, \$12,110 for research on the effect of atmospheric pressure on the mechanical properties of boundary layers.

University of Minnesota, Minneapolis, \$1,777,000 for research on the development of the state of magnetohydrodynamic instabilities; \$100,000 for research on magnetic reconnection in the Earth's magnetosphere; \$100,000 for research on the study of the dynamics of interplanetary magnetic fields.

University of Notre Dame, Notre Dame, Indiana, \$11,170 for research on the effect of atmospheric pressure on the dynamics of boundary layers.

University of Wisconsin, Milwaukee, \$1,777,000 for research on the dynamics of magnetohydrodynamic instabilities; \$100,000 for research on magnetic reconnection in the Earth's magnetosphere; \$100,000 for the study of collective instabilities in addition to \$100,000 for interpretation of information of plumes with high ionizing rate.

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University of Wisconsin, Milwaukee, \$11,170 for functional methods analysis and optimization; \$2,444 for research on atmospheric pressure and magnetohydrodynamic instabilities; \$100,000 for research on magnetic reconnection in the Earth's magnetosphere; \$100,000 for research on the dynamics of interplanetary magnetic fields.

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FAA AT WORK

New Raytheon radar-TV helps FAA give added security to air travelers

Every time you or your loved ones travel in the U.S. by commercial plane, first flight comes under the watchful radar eye of the Federal Aviation Agency's air traffic control system. Now the FAA can look after you even more effectively thanks to a new "bright display" equipment developed by Raytheon.

The FAA's air traffic control system—which has long included Raytheon radar—now adds the safety of air travelers by keeping a close check and accurate record of the speed, course and altitude of planes in flight. And this new "bright display"—one of 60 million—gives the radar operator a valuable new tool for monitoring your flight.

Conventional radar pictures, for example, show each aircraft on a single receiving line in the screen. In the new system a Raytheon storage tube collects this individualized data and presents them in a clearly visible "tableau" of each plane's exact progress and position. The picture is sharper and brighter than before.

When the FAA completed the network of "bright display" control rooms, it will make no travel safer than ever... another example of Raytheon's innovative skills at work on behalf of business, industry, science and defense. Raytheon Company, Lexington, Massachusetts.

RAYTHEON



Objectivity

If you're tired of hearing about the "perfect" printed circuit connectors, you've put the man we want to talk to.

We'd have to offer you freedom of choice because that's what objectivity begins. The boy looking his last power on today wants to be able to choose from many wants to be able to choose from many choices. His license version professionals, not been around, remain flexible. They're all good, because are perfect.

That's why we make such a variety of printed circuit connectors. Each type and style has its own special benefit. They're all "perfect" when they're applied properly.

OUR NEW HOLLOW-TYPE

Take the new Amphenol 225-series. The hollow-type connector has the smoothest gasket, most efficient sealing since you'll find anywhere. Even after thousands of insertions the delicate conductor surfaces of the printed board are unaffected by the 225.

The 225-series has remarkably low contact resistance too. For the solder terminated style, it's under 25 millivolts at 5 amperes.

The hollow-type contact on the 225-series is spike down the middle. You get two contact points for every interconnection. This helps keep the contact resistance low, of course, but it also conforms readily to irregular mating surfaces.

The 225 is proven. It needs and meets the printed circuit board with a wiping action that assures contact.

AND, FURTHERMORE

The 225-series contact is self-aligning in the connector body. Gaps

that seem well out of alignment at the slightest pull on the terminals.

The 225-series has twice the flexing range that you'll find on other bellows-type contacts. This means you can rock the board twice as far with no danger of contact damage.

The 225-series does not waste valuable contact space with a polarizing key. The key is sandwiched in between contacts.

The 225-series can be terminated with solder tags, tape pins, removable clips, or Wico Wiro[®] terminals.

Contact style? Contact position? Mounting provisions? Walk into just any store that has over 100,000 combinations available in the Amphenol 225-series hollow-type connector.

WHO NEEDS IT?

And now for the facts of life. Some people simply don't need the 225-series. Some printed circuit boards are inserted once and never disturbed again. Some printed circuits are never subjected to pull on the terminals. Some printed circuits are not really so delicate that they must be protected from contact wear. Some printed circuit boards never get tested. And in some applications the space taken up by a conventional polarizing key is of no consequence. And so forth.

And that is why Amphenol makes Pin-Cir[®] connectors, Micro-Bip[®] connectors, Micro-Max[®] connectors, and specials that haven't been named yet. They are all printed circuit connectors. They are all "tight" where the need dictates their use.

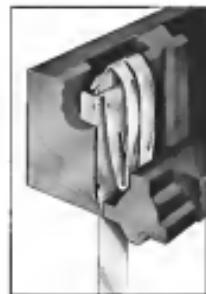
The hero of the story is the Amphenol Sales Engineer. He's the only man who has access to a complete

line. Thus here the only man who can look you in the eye and tell you exactly which printed circuit connector you need. Objectivity.

You won't have Amphenol Sales Engineers telling you about perfect connectors. They don't have to. They know better.

DETAILS, DETAILS

If you're really interested in seeing what a complete line of printed circuit connectors looks like, we invite you to write for our new 20-page catalog PC-1, or contact your local Amphenol Sales Engineer, or write to Dick Hall, Vice President Marketing, Amphenol Connector Division, 1830 South 56th Avenue, Chicago 33, Illinois.



Problem: To make contacts that give an extremely low-current drop, yet do not nor printed circuit conductors, even after thousands of insertions.

Solution: Hollow-type surface bases for soft contact. Double spring action with wide facing range. Then double platin and polish to smooth they give the mating surfaces

USAF Seeks New Microcircuit Techniques

By Philip J. Klass

Defense—Air Force's concurrent research and development program is directed toward developing new materials and techniques for an advanced generation of measurement and to applying similar concepts to design and equipment operating at microwave frequencies.

Four years ago, the USAF Electronic Technology Laboratory (ETL) began sparked the microsecond revolution by awarding contracts to Westinghouse Electric and Texas Instruments (AW, Apr. 27, 1959, p. 58). Today, there are over a dozen microsecond suppliers not counting basic facilities.

Improvements in current aircrafts are caused by natural competitive forces and do not require Air Force leadership, in the view of Dr. R. V. Noble, ETI's technical director.

IV. Student

For this reason, ETL is spending a needed \$4 million fiscal 1963 budget and plans to spend a similar total in fiscal 1964, to explore more advanced materials and techniques which may offer efficiency without passing without new funds. By fiscal 1967, ETL hopes that new technology will be ready for USAMR sponsorship of development of specific monolithic functions leading to commercial availability of advanced fracture.

- A breakdown of current and planned EELD 1964 improvement programs, according to Richard Albrecht, chief of EELD's molecular electronics branch, shown:
- One-third of the total program is spent on exploring new materials and processing techniques for microelectronics application.
- One-third is aimed at applying a more conventional functional concept in the design of electronic operating at microwave frequencies.
- One sixth is directed at investigating long new materials, such as organic compounds, which have application both to semiconductor devices and to microelectronics.

USAF has found that one of the best ways to advance maintenance technology is in sponsor development of specific pieces of "maintenance need" hardware, according to Ahlert. This forces the maintenance and equipment designer into close liaison, requiring each to learn more about the specific needs and capabilities of the other.

Frequently, this results in an entirely new, unconscious function which the experiential designer would not otherwise know could be accomplished and which the unconscious designer otherwise would not know was needed.

For example, a contract to Tess Instruments to design and build an all-instrument identity encoder has resulted in the development of two new types of encoders, one an operational amplifier and the other a die-differential amplifier.

Another such "seventh vehicle" contract has just been awarded Texas Instruments to design and build an electro-optical digital computer. Preliminary computer studies aimed at this objective have produced an optical multilevel switch with near-perfect isolation between input and output and multiplies output voltages as low as a few

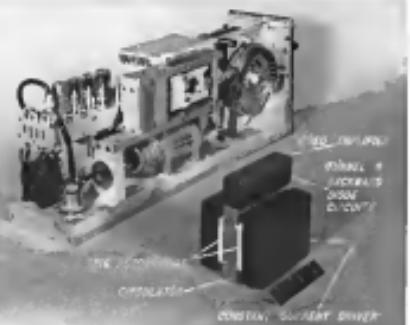
Westinghouse Electric presently is building a microturbine version of an offshore wind-turbine system for delivery early next year. Pennsylvania's Westinghouse had built a prototype WEH microturbine, the AN-ABE-63, under E.ON's contract. Nooterus research secured an ETL contract to design and build an all-microturbine digital com-

The molecular electronics branch has been developing about one-third of its budget in research and development development at the successive end of the spectrum, which has been highly, or previously, because of the large potential growth in some weight segments of imposed potentialities. The EEL program includes all types of solid-state techniques that can be used to perform functions which generally require electronic or electro-mechanical processes.

LITERATURE REVIEW

Levit Electronics Co., for example, developing an integrated solid-state broadband tuner equivalent of an existing electronic communications receiver which needs a complex electronically-tuned bandage to sweep out the operating frequency band. While the conventional ECM receiver requires 60 to 100 ms to sweep over the band (7 ge. [base]) to nearly 17 ge., the new solid-state tuner is expected to sweep the same band in only one millisecond.

Where the electro-excavated tunnel had portion of the powertrain ECM power weight 188 lb and occupies 0.90 cu in, the new Ford solid state unit is reported to weigh only 21 lb.

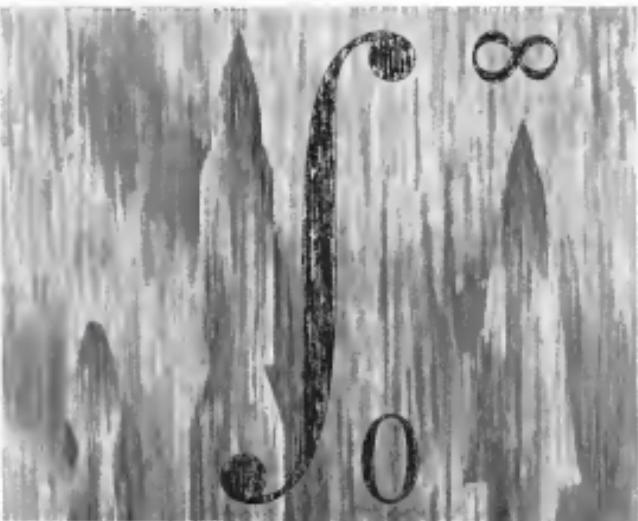


AIR FORCE IS APPLYING solid-state technology to maximize equipment stability in contested environments through using lead-free (Pb) which is the new version is expected to be the use of the cockpit (background). Solid-state PCM timer being developed by Lead Electronics, a smaller lighter, more sensitive and can run more reliable.

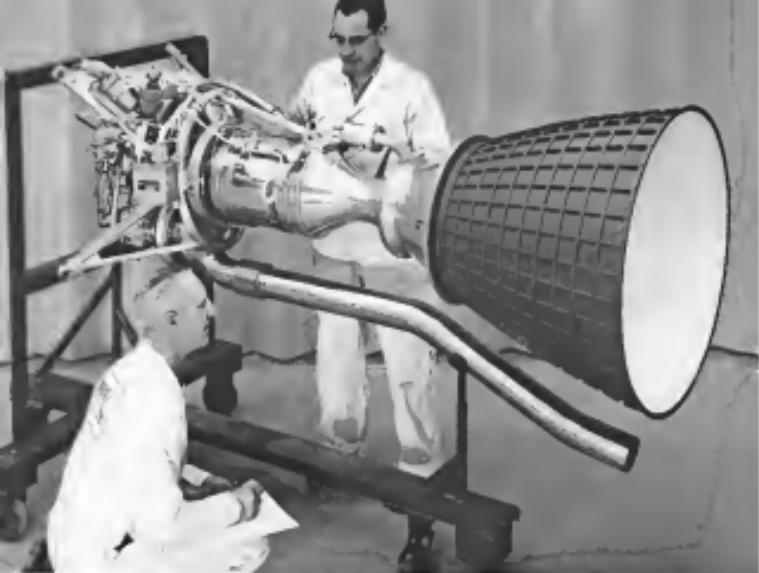
Armstrong planned and developed with a number of potential vehicle designs for any given mission. To avoid the innumerable dollar expenditures in testing even a few of these would result, industry has devised mathematical procedures that do the big job of working out the proper designs. Douglas' static and space dynamic mathematical simulation programs are among the most advanced and comprehensive in operation today. The company's research centers have developed a series of something that "folds in" themselves

MATHEMATICAL MISSILES

...AND WHAT DOUGLAS IS DOING WITH THEM *Plans to improve heating and cooling environments...even consider "buddy" between families. Another aid is a unique Douglas viewing system which allows relationships between various participants (parents, children, etc.) to be observed in three dimensions.*



Advanced mathematical short-cuts to better aerospace systems are among the numerous research programs in broad technological areas now under way at Douglas. Major Douglas Divisions are located in **Santa Monica** and **Long Beach**, California, **Tulsa**, Oklahoma, and **Charlotte**, North Carolina. 



Boeing's powerful Agam engine for the Interceptor fighter. Credit: Boeing/McDonnell Douglas

Titanium's compatibility with ceramics makes rugged, light-weight parts for ultra-high temperatures

One of the first practical examples of a unique partnership is now hard at work in space: the Agam ceramic-coated titanium nozzle extension.

Also among structural materials, titanium has a coefficient of expansion ($6.7 \times 10^{-6} \text{ in./in.}^2$) close to various materials. The useful compatibility opens up many possibilities for design, giving parts that can be subjected to ultra-high temperatures. Where today only uncoated graphite and ceramics could withstand the searing heat of rocket power, re-entry and the like, it is now possible to make aircraft in titanium. Results? ...

Take a look at the uncoated nozzle extension on the Agam. According to

Bell Aerospace Company, who designed and built the Agam engine, a layer of titanium sheet coated with aluminum oxide was able to save 20 pounds over the original uncoated graphite part. Yet it was able to give equal heat resistance and at the same time provide a significant increase in strength and ability to withstand rough handling.

The unusual titanium-ceramic relationship has increased nozzle area more than 100% over the previous model contributing to an improvement in specific impulse and engine performance. The Interceptor Agam engine has become the workhorse of the Air Force's Starfire Program, the Ranger, Maxstar and other NASA programs.

For additional data on how titanium sheet and tape can reduce and improve your heat performance related needs, contact Technical Service Department, Titanium Metals Corporation of America.



TITANIUM METALS
CORPORATION OF AMERICA
600 Broadway, New York 7, N.Y.
628-2140 2200 2202 2203

and savings of 43 cu. in. (see photo p. 81). Power ratings for the new engine are expected to be only 11 w, compared with 180 w for the conventional unit. In addition to these savings in size, weight and power savings, Abertis points an important gain in reliability due to the absence of moving parts in the new design.

Increased Sensitivity

Another feature of the solid-state tuner is the fact that because it can turn a biased diode RF amplifier, where the conventional tuning head has only a passive biased control-line, new devices as reported to have built-in enough sensitivity to -122 dbm over a range with 40 dB, according to Abertis. This is equivalent to a 120 dB increase in distance at which sig. can be detected.

Additionally, the new solid-state device will include microstrip radio amplifiers and a bolometer-diode video detector. These eliminate the need for a transmission unit in the conventional design which is large and costly in terms of the tuning head, Abertis says.

The new solid-state tuner will use VHSIC (Very High Speed Integrated Circuit) technology where memory storage can be changed by varying the strength of the magnetic field applied to the material, permitting clever tuning of the device.

Other ETI-sponsored program in the aerospace field include a contract with Vought Associates for the development of a distributed transonic flow controller which might be used to replace Hytronics in the AGM-48. Martin Marietta is investigating the P-4N type diode for use as a power switch and package as an oscillator.

ETL Programs

Programs which ETI is sponsoring in the area of advanced generation aerospace technology include the following:

- **Hybrid microelectronics** using thin-film deposited resistors, capacitors and resistors deposited on a semiconductor substrate, are being investigated by Metronics. The company is sharing the cost of the three-year investigation aimed at developing thin-film deposited resistors and capacitors with Metronics, Inc., and Spalding Electronics Corporation.

- **High frequency acoustic amplifiers**, consisting of a diamond-silicidic crystal with piezoelectric crystals attached to either end, has been explored by Texas Instruments without too much success to date, Abertis says. However, during the course of this program, it was discovered that carbonaceous whiskers which act as a current heater at low current levels will break into oscillation when the

applied voltage is increased to about 100 v. This may open the way to a new type of ultrasonic oscillator.

• **Organic materials electronic bandlines** are being studied by Texas Instruments and RCA under an ETI contract, in the hope of developing organic semiconductor devices and microcircuits. The interest in organic comes from the fact that it is easier to manipulate and control than inorganic materials. If organic waveconductor should prove feasible, this would open the door to what could eventually be called "ultra-thin electronics."

Since the beginning of electronic packaging, component designs have been limited to the maximum possible number of active devices. However, transistors and integrated circuit packages of complex passive designs require overall experimental cost.

The advent of microcavities is changing all this potentially with semiconductor microcircuits, where the cost of fabricating an active device is constantly the same as that for a passive device. It therefore becomes cheaper to use a maximum number of active devices in which active element can replace several passive devices.

Basic Circuits

This, however, requires the development of entirely new network synthesis and design techniques. For this reason, ETI is sponsoring a program at the University of California at Berkeley to investigate basic circuit functions from the basic viewpoint, with emphasis placed on maximum use of active devices.

While ETI, researchers, forecast that the associated solutions have moved faster and farther than they might have predicted four years ago, they emphasize that problems still remain.

One is internal heat dissipation with component devices that can be solved in microcircuit construction, according to ETI's William Spalding. Another is the problem of efficient connection between individual elements on a single substrate and interconnection of subcircuits with other subcircuits to form a complete subsystem.

Spalding says that methods must be devised to eliminate bonding wires which are usually used to provide interconnection and connection to the outside. One of the most promising techniques is to solder gold conductors onto the passivated silicon substrate to connect individual areas to a braid around the circumference of the substrate to which outgoing connection can be welded.

Finally, a partial solution to the problem of interconnecting individual subcircuits (interconnects) onto sub-



HYDRODUCT VHF RECEIVER operating at 21.30 mc band, was built by Westinghouse Electric Co. from commercially available microcircuits using surface-mount technology. The receiver stage includes a mix section for a transmitter and the mixer with the switch section takes a 5-v. battery.

ETL investigation, a program sponsored at Electro-Optical Systems, Inc., Pasadena, and a new one to be awarded very shortly. Efforts to date have been based on tunnel communication amplifiers which do not require patterning at present, Abertis says. The new program is expected to exploit isolated gate field-effect transistors, also called metal-oxide-semiconductor (MOS).

• **Dependence** this film single crystal body diodes, resistors and microstrip devices (except for isolators) made in conjunction with ETI, sponsored Schottel is seeking to deposit active areas and ground planes directly on a glass ceramic substrate, while Lear Siegler is working with gallium-arsenide and calcium fluoride deposition on semiconductor substrates.

- **Adaptive acoustic elements** which exhibit sensor capability are being investigated by Stanford University for possible use in self-adapting computers and robots. Earlier device developed by Stanford is an electro-mechanical unit known as a "membrane," changed in assistance to electro-plating active areas to respond to "heat" or "pressure" signals applied directly to the device. A second Stanford development is a piezoelectric ceramic which has much more rapid heating (cooling) times and does not deteriorate with use.

- **Low frequency acoustic amplifiers**, consisting of a diamond-silicidic crystal with piezoelectric crystals attached to either end, has been explored by Texas Instruments without too much success to date, Abertis says. However, during the course of this program, it was discovered that carbonaceous whiskers which act as a current heater at low current levels will break into oscillation when the



SOLID PROPELLANT PRODUCTION FACILITY-U.S. AIR FORCE PLANT 458. Lummus architect/engineering design for this propellant complex included auxiliary facilities for AMMUNITION test, propellant handling and storage considerations, and rocket-engine handling.

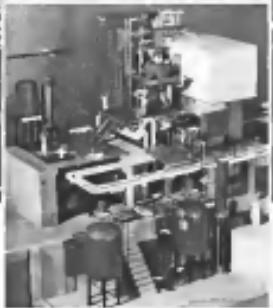


LUMINUS ENVIRONMENTAL RESEARCH FACILITY-U.S. ARMY CORPS OF ENGINEERS. Lummus performed the conceptual engineering for this simulator which established the engineering feasibility to provide for stresses up to 1.6×10^{-4} g's, temperatures as low as -423°F , and solar radiation twice the intensity of the noonday sun—up to 120 watt/day.



WORLD'S LARGEST LIQUID HYDROGEN PRODUCTION FACILITY-U.S. AIR FORCE PLANT 458. Lummus designed, engineered, and constructed the hydrogen-production process plants of this plant to produce 59.4-Mt pure hydrogen, which is then liquefied through cryogenic processes.

PROCESS ENGINEERING MODEL, U.S. NAVY PROPELLANT PLANT, NITROPLASTICINE UNIT. In addition to process design for nitroplasticine unit, Lummus performed design functions for conversion of the unit from liquid to continuous processes, for a steep casting plant to produce intermediates for possible hard application, and for alternate measurement/measurement facilities.



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created a staff knowledgeable in cryogenics, metallurgy, liquid and solid propellants, nucleonics, chemicals, physics, radiation physics, high vacuum technology, and solar simulation.

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NEW AVIONIC PRODUCTS

• **Groundscope viewing camera, Series GA-500, can be converted from multiple to single exposure and from Polaroid Land to Color cameras, with disengaging part to permit observa-**



tion of cathode ray tube during set up and recording. Compressed and high speed rates are provided at 90% of full size. Device has sliding back with detented locking position to permit programmed multiple exposures of one to nine views per exposure. Manufacturer: General Avionics Corp., 1200 East Maryland Lane, Philadelphia, Pa.

• **Optical beam splitter, for dividing unaligned portions of a laser beam, is shown reflecting the beam is available in two types. Model 471 transmits 1% of light in forward direction while reflecting remainder. Model 472 transmits 96% of light and reflects 4%. Manufacturer: Motor Optics Inc., 99 Brighton Ave., Boston 34, Mass.**

• **K-A band parametric amplifier, Type KS-1, provides 10 dB noise figure and 37 dB gain at a 70-cm bandwidth, according to the manufacturer. Device consists of a K-A band to S-band converter and two cascaded S band param-**



etric amplifiers with second-stage and an inverse, wideband K-A amplifier. Pump diodes is included in the package. Input frequency normally is 29 GHz (from 1 to 39 GHz). Bulletin 67-5 gives added data. Manufacturer: Space Corp., Santa Barbara Airport, Goleta, Calif.



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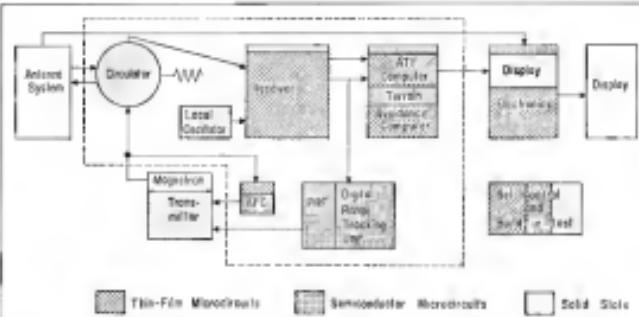


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EXTENSIVE PLANNED USE of microcircuits in Autometrics' lightweight ground mode radar, the XR-45, is indicated by shading of each major block in the simplified block diagram. Shaded portions are intended to include percentage of each block employing potential component per approach. For example, radar receiver will be composed principally of thin-film microcircuits, the remainder being conventional solid-state components. Magnetron and display tubes are the only non-solid-state electronic parts in the system.

Autometrics Designs Advanced Radar Line

By Barry Miller

Autometrics, California-based line of surface acquisition and attack radar systems for low-level, ground-wide mission, should future high-performance military aircraft be designed and developed here by North American Aviation Autometrics Avionics Control Div., using extensive computer analysis is already in design.

The new radars are being built with operating use of about 20 different microcircuits, thereby cutting the cost of a radar system by as much as 30%. This makes possible higher performance, longer range, which is expected to shorten costs and boost reliability.

Autometrics also is introducing techniques such as computer analysis and prediction of component and circuit behavior enabled so successfully in its Air Force-sponsored, \$100-million Monolithic ICBM high-reliability parts procurement program (AVW, Dec. 12, 1968, p. 99) and is applying them in the already established field of air-borne radar. The company is planning, for example, to employ in its new solid-state ground mode radar of the 19 basic semiconductor components in the early parts of development of its planned air-borne radar system for the improved Monolithic program. The ultimate objective of this company-sponsored effort is to produce radar systems which are more reliable, more easily maintained, lighter and less expensive.

This goal coincides with the increasing requirements for future military mission radars, like Navy's VAX integrated Light Autonomy Attack System (AVW Apr. 1, p. 35).

Autometrics' current is in the midst of broad-based line of new ground-mode radars. One of these is the XR-45, a single-mode pulsed radar having constant mapping, high and low altitude ground map, terrain following, and terrain avoidance features following and avoidance, using range compression. An air-to-air search mode is also added. One version of the XR-45 is being prepared to use leading system management techniques of the VAX computer system. Another version has been prepared for the integrated Helicopter Autonomy System (IHAS). Other possible applications identified by Autometrics for the family of radars include the Intertech VAX (INVA), the CN-6, the Northrop F-5, the CL-44 CONIN aircraft and Army's new surveillance aircraft. Second group of radars is the XR-47, a single mode pulsed electronic terrain following radar. This family is designed as a single mode radar which can be equipped with a terrain or air-to-air mode as required. It is intended for the same applications as the XR-45. These would include both no terrain avoidance radar and terrain avoidance radar capability. These would include both no terrain avoidance radar and terrain avoidance radar capability, as well as a terrain avoidance radar.

To reduce the present 34 to 35 hr. maintenance requirement for each hour of flight time of such airborne systems, a major effort is under way to develop a self-diagnostic system which will increase reliability. Both radar families are modular in construction with switchable at various levels, packaged separately in plug-in containers. The module level for the XR-45 (see photo p. 91) corresponds to specific



HOUSING OF AUTOMATIC TERRAIN FOLLOWING RADAR, the XR-45, one of two families of lightweight airborne navigation and attack radars being developed by Autometrics' Avionics Control Div., is shown. The model set weighs less than 300 lb. Its plug-in modules are designed to give easy function redefinition as indicated in cutaway detail. The flat screen is shown being covered from one of two modules of memory, terrain following computer. Flat plate electronically scanned antenna (right) is integral part of radar mounted in the smaller side of the radar set.

functions such as the ATR computer (not reachable), the radar receiver, the transmitter, the power supply and the magnetron.

Since these are plug-in parts, they can be replaced in the flight line by less skilled personnel than might otherwise be necessary. Faults need not then be referred to a control room and maintenance depot, similar to the Air Force aircraft guidance facilities at Brooks Osho.

The radars are being designed to obtain field upgradability or "piggybacking" of individual circuits. This will be accomplished with components whose characteristics are not critical, such as the successful modular procedure was followed in the Marinerian program. On the basis of computer analysis and an extensive life test, the variations in parameters are projected over a three-year period and only those components whose values would be expected to be within allowed corner conditions at the end of the period are used.

In the Marinerian case the stability of individual parts at the end of three years actually exceeded expectations, according to Dr. William J. Wiltz, chief engineer for advanced engineering at Autometrics' Avionics Control and Design Div. of the Monolithic program. Dr. Wiltz was not available in his present position about a year and a half ago, and brought with him several key people from the Monolithic program, including Raymond J. Sotomayor, now director research with design of the new radar.



REPETITIVE USE of the same types of circuits throughout XR-45 is illustrated in block diagram of five-channel pre-amplifiers of radar receiver—including stages from IF amplifier to through detector. Note that only these circuit types are employed here. Above: Block diagram of the stage using conventional components is shown below with a separate block without amplifier corresponding to one IF amplifier.

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Microminiature Airborne Computers

Aerospace. Cold reliability of microminiature airborne digital computers, one version of which was proposed in the current Navy competition for an integrated avionics package for the YAV-8B fighter, was described here recently by officials of Automation Div. of North American Aviation, Inc.

One design, the Model 12, is a 1.6 cu. in. clock rate control computer with an 8,000 30-bit word random access core memory capacity. An additional 16,000 p. of memory for a 16-bit word word capacity and a code rate of 1.1 million cps. Max memory cycle time is 1.6 microseconds, and access time is one third of that. The main memory can be expanded to 12,768 words.

Model C logic and memory core sections will supply 3,600 logic, transistor-transistor coupled logic, microminicomputer, memory, and a development board for it. There will be a package of 1 in. x 1.6 in. package mounted on a 12 in. x 12 in. substrate board.

The maximum word time is 4 to 12 microseconds, an average time is 10 to 45 microseconds, and code rate is 160 to 152 microseconds. It will weight 25 lb., current 8.5 on 48 v., and require 190 w. First computer-optimized flight test is planned for June of next year.

A second computer, the Model 1, intended for navigation, guidance, flight control, and radio scan assignments, is a somewhat simpler and smaller machine. A typical computer of this type will weigh 10 lb., current 0.15 on 48 v., draw 90 w., and have a 1,024 12-bit word capacity. Like the new Automation radar (that starts in the 1960s), semiconductor microcircuits are being developed for the Vought-Aviation ICM pulse compression system. First flight of this system, according to the new plan, will be in November.

Carlo programs 6,000. Each component in the circuit is varied with its expected statistical distribution of characteristics.

The computer program samples the distribution 500 times, in effect building the current 300 times. In this fashion, circuit behavior is observed and a reasonable expression of variation in production circuits is derived.

In the circuit design, an emphasis is being placed on accurate measurements since the size of component values becomes more important than individual component values.

Microscale Use

An essential element in the design of the new radars will be the extensive utilization of microcircuits. These will reduce the number of presenting stages, as in both the planes of the version which supply some microcircuits and an A-scope.

Reducing the processing steps by a factor of 100 presents clear cultural and technological advantages according to West and results in improved reliability and reduction in costs.

Semiconductor microcircuits are given top priority for use whenever they are applicable and are expected to be available within the time span of initial equipment development. Microscopic semiconductor microcircuits may be employed because their design will be the combination of several computer sections and thus are expected to benefit from economies of reliability and manufacturing knowledge.

The design will utilize a blending of semiconductor and thin film, ceramic and conventional substrate concepts.

The only non-usable article parts will be the transmission medium (antennas) and a digital table.

Semiconductor microcircuits appear most extensively in the lower frequency digital portions of the radar, such as the digital range tracking unit, the range segment, frequency tracking, the current available microcircuits, and possibly on the antenna beam-forming unit. Where there are low frequency logic circuits, or where the logic microcircuits can be used, this can give performance over thin film microcircuits, which require addition of individual transistors and diodes. In higher frequency portions of the radar that are accessible to microcircuits, such as the 60 mc. receiver, units from the 100 mc. amplifier through detection, thin film microcircuits appear to have better design components and cost advantages.

When these can be used, conventional solid-state components have performance potentially less reliable moving parts and vacuum tubes.

Frequency Bands

Both radar families can be designed for operation in different frequency bands—K, X, C, and S by using the appropriate magnetrons and substituting a suitable RF load circulator, mixer and local oscillator.

As in the current Navy XAV systems, magnetrons and mixers are stored and for a reasonably strong transmitter whether they appear in a radar or a computer—Antennas are using a reduced number of elements replicated throughout the radar system. This

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commercially purchased, are through design on fixed circuitry, thereby reducing the initial development costs, according to Robert E. Hoads, chief of advanced components at Avantech Control. It would also simplify testing, maintenance, replacement and repair.

System Components

The XR-45, West points out, will employ about 32 different semiconductor—eight semi-conductor types etched over from Monolithic and 12 to 15 thin-film types. This represents a subtle reduction in circuit types from earlier models, a typical one of which might have 45 or more designs for so common a circuit as a cathode follower. A single antenna follower, however, will be used with four transistors and will be used for impedance matching function in these new radios to replace the various antenna followers.

Of the eight monolithic semiconductor, there are four—a power switch, modulator/demodulator and a general purpose amplifier. The first digital signal is a control flip-flop, encoder flip-flop, gate, logic and multiplexing logic circuit. Typical of the circuits include an IF amplifier, demodulator, video amplifier, mixer, follower, multiplier, ramp generator and a multiplier.

This has long used multiple resistance resistors in values up to 500 ohms per leg, normally in the 100 to 200 ohm per leg range. Resistances of 50 ohms can be taken to 10 ohms by the use of evaporated conductive films.

Capacitors using gold or one plastic substrate as a dielectric and aluminum as the second electrode yield values up to 0.05 microfarads per sq in. Avantech has developed new dielectrics using blends of silicon oxide and two earth materials which have higher dielectric constants, making possible capacitance in values of 5 to 10 microfarads per sq in. Ceramic substrates are used to take advantage of their good heat conductivity.

Vacuum Evaporation

Vacuum evaporation processes are being developed with the objective of applying possible final operations in a single cycle—deposition of resistance, conductance, dielectric and capacitor electrode. Capacitor parallel will be housed in a separate cavity, however, to preserve purity in the operation.

Antennas also will have design that the end work, masking small cells, 3 in. in diameter in values of 1 microfarads per square centimeter and feeders for three frequencies probably will be packaged in hermetically sealed TOSI bags.

The uniplanar complex, which is not a direct part of the unit, also will use a hybrid combination of semiconductor

grounded for an automatic pop-up. The pilot who will have a unit which with appropriate calibration for working growth cycles in each mode.

■ Infrared data aircraft surveillance

All components are situated in a cabinet rated from 400°C cooling. Air ducts provide for passage of cooling air.

Photographs of the XR-45 workshop indicate some of the simplifications in hardware which have resulted in substantial weight savings. The radio antenna is a flat plate, electronically scanned antenna which is part of the mounting structure. This type of antenna has eliminated arms and only one mounting post, an on-boresight mechanical plane reflector, means. Electromagnetic weight has been reduced by using germanium and accurate fine wire to 6.850, 20% of the antenna's total weight. Cooling and cooling velocity also were reduced, in turn, those of the power supply and an off-the-shelf transmitter.

■ FILTER CENTER ■

► **Monolithic ASR/PAR** Radio-Film as transposable radio seen along the island of the USSR Krusenstern during a test. MA-9 spacecraft recoveries were the new AN/TZN-8, an extremely light weight combination as surveillance and precision approach radar developed by Gaffney.

► **Computer Terminal** Chinese—Experimental version of an automatic weather-buoy system developed by English has been demonstrated at International Business Machines Corp. Systems developed under Texas Air Development Center sponsorship enables a non-Chinese-speaking operator to encode 6,500 different Chinese characters using a typewriter keyboard in which time keys may be struck in sequence to define one character. Soviet experts can be expected to handle 36,000 characters or more, IBM said.

► **EEA Micro Antenna Survey**—Quartz crystal arrays of the type used in today's low frequency radars by Electronic Industries Asia to obtain dry-weather factor sales belief and orders received during November 1962. Types of antenna equipment for which sales will be sought include communications, navigation, and guidance, navigation-equipment combinations, flight control and guidance systems, solid-state equipment and miscellaneous gear, such as radio altimeters and flight recorders. EEA seeks participation of all advanced manufacturers including members of the association. Individual request forms will be kept confidential, with EEA retaining overall industry totals.



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General Electric's three classes of molybdenum sheet are described in Product Data Sheet 200-6. Write for it today.

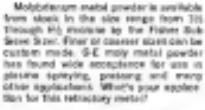
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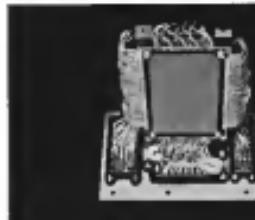
METAL POWDER—Tungsten and molybdenum powder in 99.9% and 99.95% purity are available from General Electric for almost any application requiring these metals in the powder form. They are produced by the hydrogen reduction of high purity elements. General Electric has a wide variety of tungsten and molybdenum powder sizes, types and shapes. Maximum cross section is that which can be inscribed in a 12" circle. Lengths up to 30 inches depending on cross section dimensions.



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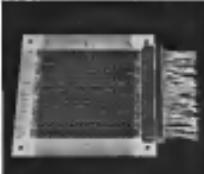
NEW RCA ADVANCES IN FERRITE TECHNOLOGY EXTEND MEMORY STACK CAPABILITIES

RCA offers Wide-Temperature-Range Stacks... Microferrite Stacks... Temperature Controlled Stacks... Conventional Memory Stacks... in virtually any configuration to meet today's computer demands.



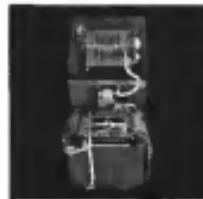
RCA WIDE-TEMPERATURE-RANGE STACKS COVER 80°C SPAN

New RCA wide-temperature-range ferrite cores permit the construction of planes and stacks that operate over any 80°C range within the limits of -60°C to +125°C without permanent loss of performance. The advantage in these applications is that small size, minimum weight and reduced physical and aqueous stresses are required. These devices can help you achieve vital space and cost savings.



REVIEW CONVENTIONAL MEMORY STACKS NEED LOW-COST REQUIREMENTS

RCA conventional memory stacks may be used where temperature extremes are not a critical problem, but where RCA's high quality and reliability are required at lowest possible cost. Hundreds of these stacks are now in use with an outstanding record of reliability.



RCA CONTROLS STACK TEMPERATURE TO WITHIN ±2°C OVER A 125°C RANGE

RCA Memory Stacks, temperature-controlled within ±2°C are designed to meet MIL Specifications. Available in conventional or high density packages, these stacks can be used where specifications call for conventional core operation over extreme temperature ranges (up to a 125°C span).

RCA's versatile line of memory stacks now includes sizes from 256 words by 8 bits to 16,384 words by 32 bits, with ferrite cores from .038" to .060" O.D. for system speeds as fast as 205 nsec.

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New RCA microferrite memory stacks complete a full read/write cycle in 300 nsec seconds with less than 256 mW driving current and bitoutputs of 30mV.

These revolutionary word-address systems, using proved ferrite cores, achieve packing densities to 3,800 bits per cubic inch. Available in multiples of 256 words by 32 bits.



Service: Your local RCA Semiconductor and Materials Division Field Representative is prepared to provide a completely coordinated application service, covering ferrite cores and memory systems, and semiconductor devices. Call him today. For further technical information, write RCA Semiconductor and Materials Division, Memory Products Department, Section 14A-8, 4141 Street, Newhall, Calif.



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HFB.320 OF HFB.320 modified aircraft shows high T-tail with blended body and jet pods underwing wing pods. Wings have been swept forward 15 deg. Note that leading gear housing has been installed under the wing.

HFB.320 Modified to Boost Performance

By Warren C. Wetmore

Hochstetten, Germany—Windtunnel testing in four nations—Germany, the Netherlands, Spain and Switzerland—has tested a series of modifications to be incorporated into the basic design of Hanover Flugzeugbau's HFB.320 "Hansi" twin-jet executive aircraft. Changes reflect the aircraft's desire to boost performance while maintaining a competitive price in the crowded executive jet market.

Prediction schedule has been maintained despite these changes, which have been effected since the first design data were announced last year (AW, May 16, 1967, p. 130). Rollout of the

first of two prototypes is slated for next October, to be followed by taxying and shorted takeoff tests prior to the first flight near the end of November.

Most apparent modification is the incorporation of air rating in conjunction with fitting of the fuselage-mounted wing leading gear housing. This alteration was made after 1/3-scale model tests were conducted in the transonic tunnel at the NBL facility in Amsterdam.

Measurement of local strain distributions in the wings were also carried out at this facility.

Less obvious is the replacement of the two aforementioned Pratt & Whitney JT17D-6 turbojet engines contained in

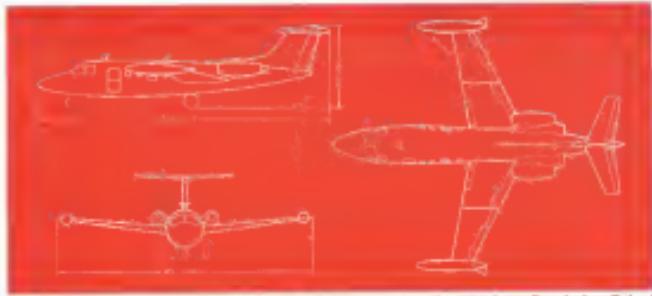
the original specification by General Electric CJ101-1 engines.

A Hanover Flugzeugbau official said the following actions for this change:

- Lower cost of the CJ101-1—expected to save \$10,000 per engine—for the aircraft's use.
- Lower specific fuel consumption than the JT17D-6.
- Greater thrust-to-weight ratio for the GE engine.

• Use of the GE engine is smaller, both in cross-sectional area and in length.

Additional to the 2,850lb thrust CJ101-1 installed in a redesign of the two aircrafts, Pratt & Whitney JT17D-6 turbojet engines contained in

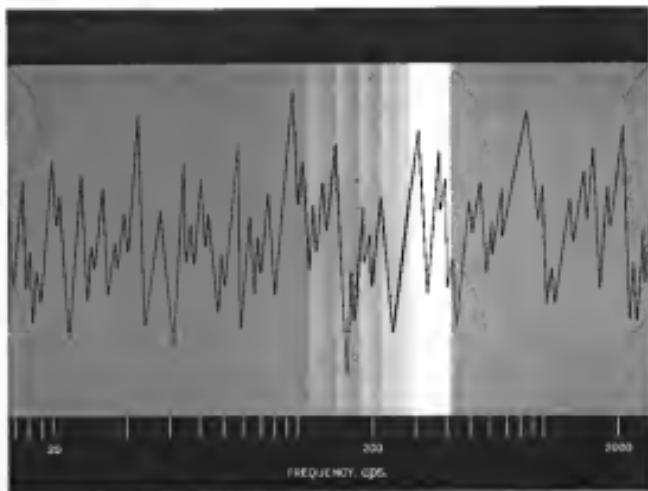


THREE-VIEW of the HFB.320 shows several design modifications, including air rating and altered engine nacelles and pylons. Outboard leading edge slats have been deleted and forward air flow has been added to the wing leading edge.



VIBRATION NEWS

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MB introduces SWEEP RANDOM— a new, low-cost method of random vibration testing

MB Electronics now offers industry the Narrow Band Sweep Random system. This new technique in random vibration testing is designed to create stresses and accelerations at 1 g levels similar to those provided in the more expensive wide band random test. It is easy to operate and inexpensive enough to be used with the smallest amplitude test system in general use today.

The new MB SWEEP RANDOM method reduces the total force required for wide band testing by averaging a slowly over the frequency range with an intense narrow band excitation, in contrast to the low acceleration intensity excitation of the wide band test.

This results in a reduction of force one third to one half the force ratings therefore required for standard model vibration tests. Con-

siderable cost savings are also realized with this new MB system.

The MB SWEEP RANDOM system is ideally suited for testing components and sub-assemblies of systems which might be given a final qualification test by wide band random techniques.

For more detailed information on the SWEEP RANDOM system write to MB Electronics, 781 Whalley Ave., New Haven, Conn.

are located further from the flange, a modification which Henselberg Design has now installed in all future produc-

tion units in the series.

Attention has focused on the weak short radius between root and tip hole, here added in the current design, for synthesis, the damping also on the outward leading edge. Also, the inward leading edge shape has been refined, however, as well as the position located at about 2/3 from the upper and lower surfaces of the 15-degree-downtilt wing. Double-slotted tips on the trailing edge are extendable to 10 deg for take-off and 60 deg for landing.

Optimal Series

Company plans to include other optional high-MI series as later production merit. These series will be made available to early buyers in schedule lots.

Over all lengths of the HB-320 has been increased from 31.8 ft to 34.5 ft for added stability. Length is now 15.6 ft, compared with 11.5 ft in the original design.

Enlargement of the tip tanks to 112.5 gal is to ensure the aircraft's range is consistent with 10.8 min. power needs required for a normal climb and the following cruise flight. Thermal fins have been added in offset due to destabilizing effect of the larger tanks and to derive part brakedown aerodynamic loads on the wings. Fins also will aid in flutter damping, according to the engineers.

Capacitance of the 110-gal. external fuel tank located between the two wings spans giving strength through the fuselage by local pressure cells is unchanged, but that of the integral wing fuel tanks has been reduced to 287 gal each. Aggregate effect of these changes is to boost the total fuel capacity from 6,175 lb to 7,585 lb and the maximum T.O. weight from 16,671 lb to 17,640 lb.

Increased Range

Still on target for 1978, Range Inc. the supplier division has reduced to 1,672 mi, with margins for a 95 mi diversion flight plus 50 min. holding at 20,000 ft, with 57% of the total fuel remaining on landing. Calculated T.O. range with similar reserves will be 1,497 mi, up in the original design.

Estimated range speed is 300 mph, 1.4 g's pitch, as opposed to the 300 mph cruise rate to which the 1.495 mi range was reduced in the original design. "High" power speed for a 100% range is 1,466 mph, an increase of 11 mph.

Service rating of the aircraft with both engines operating is 19,000 ft at a weight of 15,610 lb.

Other wordy details involved in test

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Gyro Test Servo Model 1010 — for controlling table position during gyro testing. Delivers 1000 lb at 1000 rpm. Includes a 1000 rpm motor governor and frequency range 400 to 3000 rpm. Intermediate wide range of gyro static stiffness — 2000 to 5000 N/m in rad. results in high performance. Compensation resistor stabilizes servo for gyro time constants up to 10 sec.

Table Servo Model 1010 — for class-A loop around integrating gyro during tumble or static tests. Features cheaper stabilized DC servos for high gain and low drift.

Gyro Servo Model 1020 — for use in testing 10 and 25 RPM accelerometers. Interdigitated lead frame construction, completely transistored, is available in two models. Model 1020 has a 1000 rpm motor, a 1000 rpm motor governor and frequency range 2000 to 20000 rpm. Intermediate stability of 0.01% per 100 hours. Used to supply power to 2 or 3 phase gyro wheel motors.

Motor/Supply Model 2030 is an amplitude stabilized AC servomotor for exciting vibration signal generators, resistors and inductors.

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Patent Pending on the problem of selecting VLF channels in short order with the EICO 1000. Because of computer Digital Select any frequency from 100 to 300 Kc can be selected in 0.01 sec. Avoid loss of monitoring capability due to:

- Change in frequency selection of a VLF receiver
- Shutdown of transmitter for extended monitoring

• Interference from stations on nearby frequencies



NEW TENSION LATCH



TYPE 69L

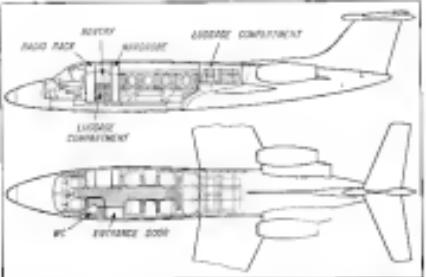


On October 10, Canaveral had a problem: low temperatures were making lox filters fail during missile loading, resulting in contamination of the missile's oxidizer.

On October 11, we were called in. Two weeks later, we had licked the problem and designed, manufactured, and delivered the new filter units.

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CUTAWAY AND SECTION VIEWS of Hawker Siddeley HS 125's twin passenger configuration show where four of the filters, including the 36-in. lox filter required in the rear, Seven-passenger version was on order at the time Air Force

ing the HTB 320 design include those at the Max Planck Aerodynamics Institute (AVAG) in Goettingen, Germany, the Swiss Federal Government, at the Swiss Federal Institute of Technology (ETH) in Zurich, and the National Aerospace Technology Institute (INTA) in Madrid.

An airframe cell for static stability testing and a partial airframe are on the static construction. Hawker Siddeley Flight Research plans to conduct 15,000 hr of flight testing, along at up to more the normal pressurization differentials of 3.5 psi—the equivalent of 30,000 m (100,000 ft) flight level.

Staging Tests

Tests on a full-scale functional model of the HTB 320 fuel system are under way, and parts of the avionics have been tested with respect to clearance differences. Final validation for the cables and connectors has also been completed.

General Electric will conduct 150 hr of tests on the Sargent variable propulsive thrust thrust system, which will be optioned equipment.

In addition to General Electric, the major HTB 320 subcontractors include:

- Fokker (Amsterdam)—wing design
- Siebel (Dortmund)—wing production
- CASA (Madrid)—canopy, fairings, etc.
- Hawker Siddeley (Farnborough)—interior
- Flight Refueling (Blaauwkapel, Engeland)—fuel system

Testing operations at Farnborough Aerospace's main plant here is nearly complete.

Canaveral estimates that the total cost for the development of the HTB 320 through the first flight trials will

be \$4.15 million, of which approxi-

mate 20-25% will be borne in varying amounts by the subcontractors and

Hawker Siddeley. The program is hoping for official government support in the form of a 5% of the \$7.5 billion German Federal Republic budget appropriation considered for subsidizing aircraft research, design and prototype fabrication. The measure is said to be making "good progress" in the Bonn government, but it is not yet known whether the funds will be available before the end of the year.

Finally, price of the HTB 320 is currently quoted at \$165,000 to \$185,000—depending on the optional equipment desired. 4-120 are produced.

Fine Orders

To date, three firm orders for the aircraft have been received, all from private enterprises within Germany, and others are being negotiated. Several non-European firms are said to have expressed interest in the HTB 320.

Hawker Siddeley has been negotiating with the U.S. Federal Aviation Agency and the German counterpart, the Luftfahrtbehörde, for certification of the HTB 320 in the two countries. Certification tests will be conducted at the German Aerospace Research Institute (DLR) in Bremen, Germany.

Delivery of the first production aircraft is scheduled for the end of 1984, which will probably be later than such projected trials as the Dassault/Dornier 300 DDF.

European sales of the HTB 320 will be handled by the Tavolar Group, which has facilities in Germany, Bel-



SOMETHING LIKE ORVILLE AND WILBUR

They started with a concept. It's been refined to say the least. Today's aircraft with a 1900:1 lift-to-weight ratio—have a much higher load-carrying strength-to-weight ratio known and other excellent properties. We have also seen some refinements.

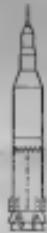
Take rockets and space vehicles for instance.

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6ix

Alcoa's Carl Anderson inspects new aluminum on narrow extrusions in aircraft wings.

This is the man who took the welds and weaknesses out of hollow extruded shapes





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with authority
on hollow extrusions
in aircraft alloys

Carl Anderson is superintendent of Alcoa's big-press extrusion plant. With two 14,000-ton presses and a 3,000,000-lb. stretcher at his command—plus his 20 years' experience in extrusion technology—he stays a step ahead of the competition and turns out a quality product that keeps other extruders of aluminum scratching their heads.

For example, Carl oversees Alcoa's capability to produce seamless hollow shapes in strong alloys like 2014, 2024, 7075 and 7178. He and other Alcoa engineers have developed techniques for producing shapes like those illustrated above with die and mandrel, eliminating welds and other problems associated with the bridge die method.

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lighter, less expensive components to replace complicated assemblies and weldments.

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ALCOA

Aerospace Industry Financial Results—1962

Financial results for a representative group of 15 aerospace industry companies are listed with comparative figures for the previous three years. Most major aerospace companies are included, though some are represented by portions of their nameplate companies. A group of smaller and subcontract producers also are included, along with major corporations with significant aerospace interests in addition to their primary commercial businesses. For comparative purposes, figures in parentheses are debits.

| | TOTAL (in millions) | | EXTRAORDINARY (in millions) | | | JANUARY PER SHARE | | | SALARIES (in millions) | | | PROFIT MARGIN SALES % | | | EQUITY MARGIN NET PROFIT % | | |
|---------------------------|------------------------|-------|--------------------------------|------|------|----------------------|------|------|---------------------------|-------|-----------|--------------------------|-------|-------|-------------------------------|-------|-------|
| | 1962 | 1961 | 1962 | 1961 | 1960 | 1962 | 1961 | 1960 | 1962 | 1961 | 1960 | 1962 | 1961 | 1960 | 1962 | 1961 | 1960 |
| Alcoa-Alcoa Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1960 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1962 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Alcoa-1961 | 2,070 | 2,070 | 1 | 1 | 1 | 1 | 1 | 1 | 1,000 | 1,000 | 1,000</td | | | | | | |

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PRODUCTION BRIEFING

Brown and Root, Inc., New York, is studying the feasibility of three types of mobile nuclear powerplants to deliver more optimum power levels, evaluate technical problems and to assess cost factors involved with advanced-burner plants, shorter construction times for large-scale and high-headplants for nuclear power. Study is sponsored by a \$11,000 Navy Bechtel of Tests and Checks contract.

Bell Helicopter Corp. has been awarded a \$4,015,934 Army contract for production of 150 GH-115 light observation helicopters. The contract resulted from competitive negotiations with Bell and the Hiller Aircraft Corp. for an off-the-shelf contract.

Spectro-Physics, Inc., won a \$185,000 contract from Goddard Space Flight Center to provide instrumentation for a magnetometer experiment to be flown on the 1969 flight around the Moon. The magnetometer will compensate for the earth's magnetism to within 0.001%.

General Electric TF-97 surface engine for the North American B-570 Mach 3 reconnaissance bomber has been run for 3,500 hr under sea level and simulated altitude operating conditions up to 70,000 ft. Of the total, 584 hr were at conditions above Mach 2. Future of the aircraft is in doubt [AW Mar 30, p. 23].

General Research, Los Angeles, will develop a man-crew environmental control system for use in a Gemini-type space station. It is McDonnell Aircraft Corp. The \$100,000 contract calls for delivery of three of the environmental control stations.

Bentley Corp.'s Bentley Pacific Div., North Hollywood, Calif., will supply the flow-coated valves and armature cylinders for the Air Force B-58 Hustler under a \$2.5-million contract from Convair Division Corp.

General Precision, Inc.'s Infrared Systems Group will supply additional microchannel warfare computer systems for weapon control, under a \$1.3-million contract from U.S. Navy.

Fireball, Canoga and Instrument Corp. will build passive camera systems and stabilized mounts for the RF-4C reconnaissance aircraft under contracts from McDonnell Aircraft Corp. worthling over \$1 million.



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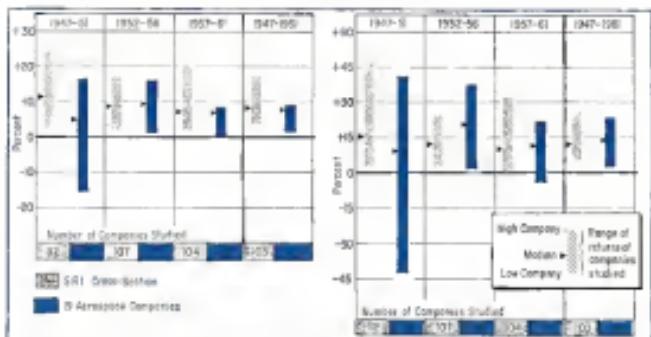
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FINANCIAL



COMPARISON OF AEROSPACE INDUSTRY profitability with non-aerospace companies is tabulated by Stanford Research Institute as shown on total assets (left) and returns on net assets (right). Total assets are those shown on the books of the balance sheet, with depreciation and pension payments excluded. Total returns are those shown on the books of the balance sheet, with dividends and pension payments excluded. Returns point to median assets (the size of the ninth or 50th percentile company in the 5000 non-aerospace firms). They show the spread between the top and bottom companies. Returns on total assets indicate a lack of spread between profitability of the top and bottom aerospace companies and the closure of the top firms to the median. The non-aerospace companies included here are a sample selected by SRI, and all are among the top 500 U.S. corporations. Most of the 19 aerospace companies (left) are also included in the top 500.

Report Cites Industry Reliance on Leasing

By William H. Gargay

Challenging complexion of the aerospace industry, as depicted in an Aerospace Industries Association sponsored study, reflects two areas of potential financial significance: lengthening allowable payment patterns and increased use of leasing.

Of the two, which has a more direct effect on relationship, the use of leased facilities or equipment has been referred to, but not lease were long-term indicators to the financial strength of the industry.

Growth of leasing has been encouraged by an amendment to the Armed Services Procurement Regulation concerning allowable. Lease payments are allowable start before payment for debt, which might be used to purchase facilities in the future, are not.

On deductability of interest payments may offset the advantage somewhat. Even so, the industry's use of leasing appears to be strengthening over time, as is financing in the aerospace capital structure.

Assumptions of the cost magnitude of leasing in the industry's financial profile

is not as easy as doing so for other capital items because monthly cash rental payments are shown as linear start payments. Debt, however, is shown as a specific sum on the balance sheet, not only in terms of payments due one year, but also in the aggregate with maturity dates.

Nonetheless, leasing often represents substantially the same kind of obligation as debt, including interest which is contained in the annual rental payment, and the full measure of it needs to be understood in any analysis of the industry.

Difficulty of assessing its impact lies in the lack of any formal accounting system for leases and because the lease payments may represent a relatively short-life part of equipment being

AEROSPACE MANPOWER COMPOSITION 1947, 1955, and 1961

| | 1947 | 1955 | 1961 |
|--|--------|---------|---------|
| Total employment in industries surveyed ¹ | 30,300 | 111,611 | 399,364 |
| Direct employment in percent of total | 77.1% | 26.7% | 44.4% |
| Indirect employment in percent of total | 22.9% | 73.3% | 55.6% |
| Engineers and scientists (estimated) as percent of total | 17.3% | 9.4% | 5.8% |
| Other technical employees | 12.3% | 14.2% | 21.2% |
| Technicians as percent of total | 3.9% | 10.2% | 4.1% |
| Technicians per 100 engineers and scientists | 29 | 12 | 12 |

1. Aerospace companies reported manpower data for 1947, 1955, and 1961. Total of the same companies reported manpower data for twenty-three activities for 1955. Total of the same companies reported manpower data for 1961.



Who told the pilot his IFF transponder, UHF transceiver, ILS display and TACAN systems are operational?



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absorbed, in effect, over seven years in a building with a useful life of 20 years.

Because of the scarce information available, the economic technique of analysis is to estimate annual rental payments at an arbitrary rate. The Stanford Research Institute study quoted cited by AIA developed such estimates on publicly reported and privately supplied data of 12 aerospace companies. Using extrapolation rates of 14% and 10%, the study estimated average total value of leased equipment for the 1957-61 time period at \$370-\$750 million.

In another analysis, using data from 32 aerospace companies to make up an appropriate sample and for the years 1949, 1951 and 1961, the study measured increases in interest and lease payments as a percentage of sales. Thus, there is:

| | | |
|----------|---------------|---------------|
| Interest | 180% vs. 1951 | 180% vs. 1959 |
| Lease | +120% | +170% |
| Total | +160% | +210% |

Put in terms of actual amounts and as a percentage of total sales, the economic point and last statement showed the following:

| | 1949 | 1951 | 1959 |
|---------------|--------------|--------------|--------------|
| Interest | \$12,000,000 | \$12,000,000 | \$16,000,000 |
| Lease | 1,000,000 | 4,000,000 | 10,000,000 |
| % of interest | 8% | 4% | 6% |
| % of sales | 1% | 1% | 1% |

**TAXES REPORTED PAID BY
A GROUP OF AEROSPACE
COMPANIES**
(Millions of Dollars)

| Year | Retained Profits ^a | State and Local Taxes |
|------|----------------------------------|--------------------------|
| 1949 | \$400,71 | \$16,0 |
| 1950 | 27,6 | 16,9 |
| 1951 | 21,5 | 16,4 |
| 1952 | 48,5 | 21,1 |
| 1953 | 21,1 | 16,3 |
| 1954 | 230,6 | 20,9 |
| 1955 | 210,6 | 20,9 |
| 1956 | 240,5 | 16,4 |
| 1957 | 237,2 | 17,3 |
| 1958 | 410,8 | 16,8 |
| 1959 | 442,6 | 16,9 |
| 1960 | 290,7 | 16,2 |
| 1961 | 187,8 | 16,2 |
| 1962 | 301,3 | 16,2 |

^a 10 companies, 1949-51; 14 companies, 1952-53; 14 companies, 1954-55; 14 companies, 1956-57; 14 companies, 1958-59; 14 companies, 1960-61; 14 companies, 1962-63. Sources: Aerospace Industries Association, Washington, D.C.; Defense Department, Washington, D.C.; Defense Supply Agency, Washington, D.C.; Defense Contract Audit Agency, Washington, D.C.; Defense Accounting, Washington, D.C.

^b Not adjusted for estimate of excess profits assessments to determine the tax base of the individual companies.

Source: Derived by Stanford Research Institute.

These figures show that both interest and rental payments are growing in significance, especially since 1955. This could be expected as a natural consequence of the government policy, by giving in the late 1950s of requiring more capital investment by the defense industry and of requiring the industry to assume a greater element of risk.

Perhaps less obvious is the fact that interest payments, despite their greater percentage increase over the period, are a smaller absolute amount of revenue than capital revenue. Furthermore, growth of total payments appears to have ac-

celerated later after 1955 than interest payments have.

The real significance of the growth in leasing is to be found in the effect leasing can have on the total capital structure of the aerospace industry.

Stanford's study does not deal directly with the question. Its estimates on leasing were developed along with those for the value of government programs related to the aerospace industry for demonstrating the viability of an expansion of aerospace industry revenues with probability of non-defense contributions.

(Continued on p. 417)

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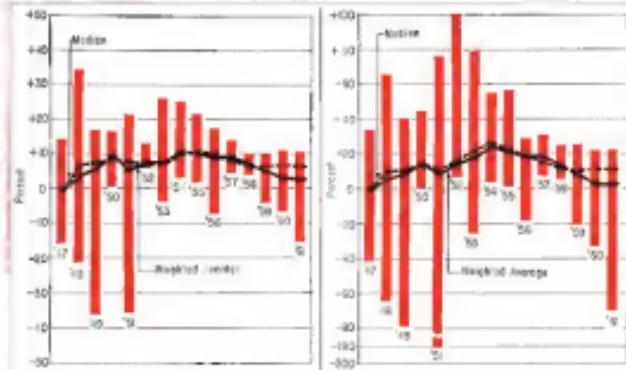
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RETURNS ON TOTAL ASSETS for individual years is shown (left) and on net worth (right) for the 19 aerospace companies analyzed by Standard Research Institute. In addition to the annual levels, the average return in each company is plotted, weighted to reflect the differing size of the companies in the sample. Number of aerospace firms in the Standard study varies because of the differences in available data and the year of emergence as a major company within the industry.

These returns are shown in the tables on p. 113, with the primary emphasis in the study on return on total assets, a method not commonly used to prevent concentration on the profitability of the defense business. As indicated in the table, average returns were generally less than that of non-defense companies. This is true whether on a median basis, that is, the halfway point in the list of companies—or on a weighted average basis that puts more emphasis on the needs of large firms.

As a matter of considerable significance, the average return in the aerospace study tends to fall below the norm, the study tends to fall below the norm, showing relatively lower profitability of the large companies.

Evaluation of the importance of the growth in leasing is dealt with in full detail in another study of the aerospace industry, distributed at about the same time as the AIA report. This can be done by the Arthur D. Little Co.

Admittedly, the figures must be approached with caution because of the vagueness of available information and because of the various possible terms, conditions and types of leasing. Even so, the Little study does not seem to indicate much growth in the aerospace industry, against the Standard Research figure based on 12 or 13 companies.

Interpretation of the significance of a growth in leasing contingently is left to qualification.

In the Little study, the leasing rate

rate is complemented by a set of assumptions of the value of the industry's use of government facilities—assumed to have a net total value for the 51 companies of \$2,345 billion in 1956 and dropping to \$1,782 billion in 1961—and of growth percent in the government's use of aerospace.

(The Standard Research estimate for gross value of government property employed in 51 companies is an average for the 1957-61 period at \$1,579 billion.)

Estimated value of government and

transferred property was added to a 51-company corporate balance sheet and then used earnings on government property to add to a corporate profit and loss statement to attempt to reflect for the added return the industry's presumably small gains on such property as it was privately owned.

Adjustment also is made to obtain interest rate from earnings that would be required if the government advances were obtained from private lenders.

Results of all these computations

COMPARATIVE RATES OF RETURN ON NET WORTH FOR 19 AEROSPACE COMPANIES AND SELECTED SERIES 1957-1961

| | 19 Aerospace Companies | | Industrials Series (Weighted Average) | | | |
|-----------------|------------------------|------------------|---------------------------------------|-------|-------|-------|
| | Median | Weighted Average | 1957 | 1958 | 1959 | 1960 |
| 1957 | 10.5% | 18.4% | 12.9% | 16.2% | 12.9% | 13.1% |
| 1958 | 12.5 | 19.8 | 9.8 | 6.5 | 10.2 | 12.3 |
| 1959 | 10.0 | 8.0 | 10.8 | 10.8 | 11.4 | 9.6 |
| 1960 | 11.8 | 3.2 | 10.8 | 9.1 | 10.2 | 11.0 |
| 1961 | 11.0 | 2.6 | 10.8 | 6.7 | 10.1 | 9.6 |
| 1957-61 average | 11.0 | 8.9 | 10.8 | 9.4 | 10.8 | 11.0 |

*Weighted average computed by aggregating earnings and net worth for the 19 aerospace firms. Derived by Standard Research Institute.



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show that profit margins on sales increased slightly—from a published 1.5% in the SEC/PTC survey for 1961 to 2.1% measured with an industry average of 4.5%. On net worth, however, the return for 1961 was from 9.3% to 10.6%, which is above the all industry average of 9%.

While this is an interesting contrast, the fact is that government officials are not likely to be much concerned about net of return percentage points so long as the industry is willing and able to deliver weapons under the present rules of production and procurement. The profit margin of the industry, in effect, represents at a cost for use of government facilities and advances.

More significant is the change in another area in the armed services balance sheet—debt/equity ratio. This figure has risen an awful 35% in the 31-company survey for 1961—that is, 29 cents of debt for each \$1 of equity in the form of common or preferred stock as contrasted with 1.3¢ on the basis of 1960.

Although businesses like the airlines can afford a 3.1 debt/equity ratio, the main industrial companies as a rule by 1961 is 1.1—1.3 maximum for manufacturers, and the aerial land for SEC/PTC all industry never was 2.5.

The conclusion can be drawn from this analysis:

- **Financing requirements** of the defense industry will increase markedly if government policy continues to demand more and more industry investment in facilities.

- **Increased equity** financing as a result of the potentially high debt/equity ratio is likely to be necessary, and with the industry's relatively low return it is open to question whether the private capital will be available.

The Little study does not consider the industry as dire trouble, but does say that it is treading on dangerous ground. A change in AFPR to double losing costs would have an obvious deep impact on industry's earnings.

While the government is not likely to deliberately let the defense industry collapse, with the consequent endangering of national security, there is danger that the government will fail to recognize the need to signal in time, the Little study says.

With interest rates generally down depreciation also low, the Little study was of potential trouble for the industry in the 1970s.

Against the question of government property, the debt/equity ratio for the industry using the preceding losing estimates in capitalization is .75. This level is high, though, again, we remind of for manufacturing companies.

At long last defense and space spending remains high, as they show every sign of doing, the industry no doubt

can earn the obligation. But the industry must a strong question as to the effect of a major reversal of this trend—a genuine disinvestment program, for example. Not only would a sudden shift in defense spending affect the defense industry directly, but the impact would remain itself through the linkage and lessons in this case and eventually reverberate through the entire economy.

The impact of the entire question of defense costs on the industry is not nearly large, in monetary terms, the Standard study indicates, but it does have a more significant role when compared to the rest of the economy.

As a percentage of net tax earnings, the average must draw 5% to 14% from 1953 to 1958. Presumably, the company whose business was predominantly defense had less cost drawdown

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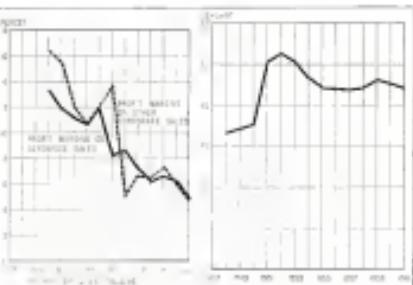
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size. For companies with heavier proportions of commercial sales, the percentage ranged from 79% to 90% total sales in about 25% of the same period. Data after 1955 is not used because of distortions caused by losses on jet transport development.

Included in the study is a tabulation of cost items disclosed with the von Braun was first disclosed, showing the trend in nondefensiveness. It shows:

- Technical displays, first disclosed in 1953
- Unpublished contracts, 1955
- Business conferences, 1958
- Bid and proposal expense, 1958
- Employee training expense, 1958
- Foreign office expense, 1958
- Operation of executive airplane, 1958
- New York purchase tax, 1959
- Personal property tax, 1963
- Patents expense, 1961
- Public relations, 1961

In sum, the most important nonallowable costs, the survey indicates, are in travel expense, advertising and selling and research and development. The latter reflects a government policy to encourage cost sharing in R&D contracts, as most company-sponsored R&D contracts are cost shared. R&D cost makes up 90% of a \$2.49 billion total, based on data from 15 companies, according to the study.



DEFENSE WORK on defense work (solid line) and non-defense work, based on data from companies that have substantial balances of both kinds, are shown on chart left. The figure prior to 1953 is only, since defense work figures are slightly lower. Most significant perhaps is the decline in profit margin on defense. Companies included are: Minneapolis-Honeywell, Sperry Gyroscope, Thompson Ramo Wooldridge, Radio Corp. of America and Westinghouse Electric Corp. Subcontracting trend (right chart) shows the level has remained stable since the Korean war, despite strong efforts to encourage greater use of subcontractors.

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Waco Aircraft Co., of Troy, Ohio, has merged with Aero Industries, Inc., of Boyertown, Pa. Blaage was effected by a stock exchange. Waco will provide Aero Industries with complete aircraft production facilities for the last three years.

Teledyne, Inc., of Hawthorne, Calif., has acquired Control Dynamics Corp. of North Hollywood, Calif., through an exchange of stock. Control Dynamics is a manufacturer of measurement and automation systems for mobile and space vehicles.

General Technology Corp., Toronto, Calif., has agreed to buy the vacuum products and equipment lines of Royal Research Corp., a subsidiary of Royal Industries, Inc., Pasadena. The newly acquired units will be operated as Royal Research Div. of GTC at existing facilities at Pasadena, Calif., with present personnel. The acquisition is designed to complement and broaden GTC's activities in the field of ultra-high vacuum and space simulation. Terms of the sale were not disclosed by the companies.

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McClellan Group's Reaction Mixed On Rubel Procurement Proposals

Washington—Central question in the current discussion of military procurement reform is whether there is a better way to develop the information on the quantity of defense needs to select the best bid.

From the discussion is a memo released written last August by John H. Rubel, defense deputy director of the office of defense management, summarizing and summarizing several by the Defense Industry Advisory Council. The memo was discussed June 6 by the Senate Permanent Investigations Subcommittee on contractors with its probe of the F-111 (TFX) tactical fighter contract award (AW [June 18, p. 37]).

The major charge under the memo would be to eliminate military source selection boards that now recommend to the defense contractor who should get the contract. The military source evaluation groups, which now report to the selection boards, would still evaluate to function, but they would only analyze proposals, not select one systematically, but as to who should be awarded the contract.

Subcommittee reaction to the proposed change was unpredictable to transparec, with Chairman John L. McClellan (D-Ark.) and Sen. Edward S. Moseley (D-N.C.) representing the poles of their viewpoints. Sen. McClellan and the recommended procedure may call for Section 2271, Title 10 of the 1958 Armed Forces Act, which states that in an awards design competition, military source selection boards, the recommended selection boards, the recommended selection boards.

Sen. McClellan also expressed concern about licensing in the classified "parent organization" that Rubel wrote to Deputy Secretary of Defense Russell L. Ogden. "It turns out in practice," Rubel said, "to be a conflict of interest. But Rubel and both he and Ogden promised Allen to resolve. Allen is the one industry representative on the subcommittee who favors the present source selection procedure over the proposed. And there is wide support within the 23 member council for the recommended change in the test.

Both are encouraging military source selection boards, the last draft of the Rubel memo as presented to the special subcommittee to the Defense Industry Advisory Council, recommends telling leaders ahead of time the weights to be assigned to criteria, explaining to the subcontractors how the winner was chosen, giving prime contractors latitude in affecting their subcontractor

to take any power away from the defense secretary, "but I am equally opposed to relegating the military, the lighting men, the people on whom we most depend to the final analysis for our defense if we make it necessary, than from making one contribution to that decision, just as I believe that an a position of neutrality in some cases doesn't amount to anything." Sen. McClellan commented that military source selection boards, named as the defense secretary would not be as valuable as a formal military source selection board.

Sen. Moseley and Rubel agreed—that recommended reforms were designed to bring "to the attention of the top decision-maker the alternatives which were previously deleted at some later meeting of the department so that the top decision-maker himself can also second-guess the alternatives as well as weigh against the final recommendation which has been submitted to him."

Sen. Herman M. Jackson (D-Wash.) said he was concerned that eliminating military source selection boards might upset the system of checks and balances so fundamental to the governmental structure.

The Defense Industry Advisory Council advised the Rubel memo recently at its meeting of May 3-4. The memo was presented by a special subcommittee, consisting of Rubel as chairman and members G. B. Thornton, chairman of Latin Industries, William M. Allen, president of the American Thomas Industries, chairman of Northrop Corp., and Mr. F. A. 111 contractor, Allen offered to resign from the subcommittee for fear that might be a conflict of interest. But Rubel and both he and Ogden promised Allen to resolve. Allen is the one industry representative on the subcommittee who favors the present source selection procedure over the proposed. And there is wide support within the 23 member council for the recommended change in the test.

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and will have more choices of attaining the maximum potential of the contract, and establishing at the defense secretary's pleasure special advisory boards to analyze the differences in competing proposals. High priority off cuts could be represented on these ad hoc boards.

These are the highlights of the stated recommendations.

• **Reducing costs.** Permitting excessively large numbers of bidders to compete for extremely long periods is extremely wasteful of valuable resources, especially scarce technical manpower resources.

Top-Level Judgment

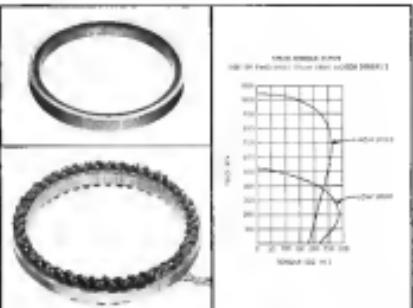
• **Downsize teams.** The source selection procedure should not, and should tend to extend decisions from successively broader levels which over time, must be turned through to completion almost automatically and then tested all over again if further refinements or modifications are required. We, the others, include the exercise of top-level judgment and place a barrier between senior representatives of the Defense Dept. and of industry which impedes or retards with a resulting that resulting of much in enabling the effective discharge of high-level understandings and responsibilities.

• **Facilitating competition.** The manner in which selected are selected plays a major part in creating that market place and influencing the degree to which the values of the best source are engendered. The criteria that are used in selecting contractors are very often the simplest criteria and are not both as objective and as fair to the government. It is essential, therefore, that the proposed criteria used in evaluating bidders shall be known both to those who compete and in those who will evaluate the submitted merit of the bids and bidders. Industry is apprehensive to defense needs can be adequately addressed if suitable evaluation criteria are established, publicized and utilized throughout the source selection process. . . .

Final Outcomes

• **Selection responsibility.** Selection should not be equated with selection, and recommendations should not be made in a context which gives them the force of final decisions.

• **Defining scope.** It is essential that the scope and content of each selection action be carefully defined in advance. What is covered by government source selection actions and what is not. What should be the relationships among prime contractors and major subcontractors? A major source selection which, for example, places heavy weight upon the formulation of incentive con-



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most provisions by the prime contractor were to allow for the creation of key subcontractor relationships consistent with that requirement. Government procedures must be consistent in this regard if power is to be given to incorporate contracts, policies cannot be applied which dictate or restrict the choice of subcontractors as it was which caused excessive management or negotiation time. Likewise, when several prime contractors are to be represented on a single project, selection procedures and documents must permit the association of all bids "in context" and not in isolation from one another.

• **Specifying bids.** Such bids would not require very much preparation, but they would require the company to familiarize itself with the general objectives of the proposed program and to furnish valid statistics concerning the company's capabilities, vision, intentions and past experience and performance in the pertinent area, technology and compatibility. The selection phase is concerned with capabilities and intentions, not with proposed solutions to the particular project. The principal criteria and the "spaceworthiness" nature sought to be given to them should be made known to the bidders during this phase.

The process would narrow the field to no less than three nor more than eight bidders.

• **Regular bidding phase.** During this stage the bidders would be required to exercise (but not to delineate) their proposed technical solutions and approach, although their incentive proposals with respect to time, performance, quality and cost. The bidding phase should not be construed as a method for acquiring a large volume of fee design information. Neither the specifications need to have full bidding, nor the bid submittals themselves, should be viewed only by industry or by government in the test used in establishing the character and defining the scope of the final program.

• **Evaluation group.** The panelists and the composition of the evaluation board would be largely unchanged from present practice. The evaluation board (that can be several on a major procurement) would be set up to accomplish evaluation, and evaluation only, not selection. A key point concerns the establishment of the appropriate criteria to be used by the evaluation board. These criteria and their relative weight should be established by the evaluation board itself. For example, an order to undertake for the bidding qualification phase. These criteria, as have stated earlier, should be made known to the industrial evaluation period.

The usefulness of the seven criteria by the evaluation board will depend

largely upon the criteria that are adopted by the board as a basic for their work. It is important to recognize that these criteria can be made meaningful if they are too broad, and will be of greatly diminished value if they are too specific. In any case, the results of the evaluation board must be subjected to a "cross-examination" review, and tested for the effects of "perverseity."

It is essential that the broad criteria be clearly understood, by the evaluator and by industry alike, but it is equally important that these should not be treated as an inflexible list for a merely numerical appraisal of the bids.

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to make, but certainly by the responsible secretary."

* Advisory boards. The subcommittee and the individual service secretaries and defense secretary may wish to name a source selection advisory board to assist in evaluating competing proposals for a major contract. The board might be entirely military officers or include civilians.

"Above all," the report said, "the advisory board needs to be a working board. It must assess the results presented to the secretary by the evaluation

board—the advisory board is not there merely to satisfy us to examine recommendations of the evaluation board. The advisory board should propose a written report to the secretary. The report should analyze the principal observations of which the review committee was made. It should describe the pertinent highlights of the review relevant to the review evaluation process and depict the principal criteria that were established in evaluating proposals to conduct the activities of the evaluating board and summarize these principal findings. Finally, the advisory board should recommend the manner in which it has assessed these findings, and it should present the principal interest of the review committee. Arguably, this task has in support of and in opposition to each alternative, and the often perturbation of criteria and weightings used in evaluation should be

presented.

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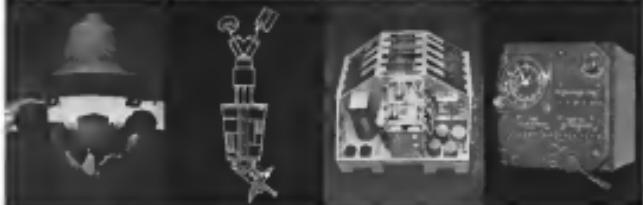
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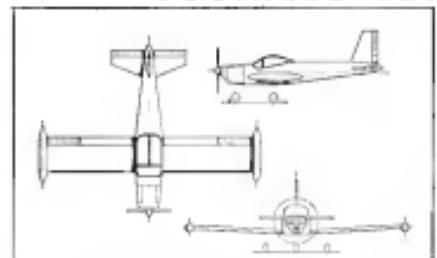
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Siat 223, shown in three-view, has cantilevered wings and interchangeable control surfaces. First prototype is under construction by Siebelwerke-ATG GmbH.

Siebelwerke Building Prototype Of Siat 223 Aerobatic Trainer

Dortmund, West Germany—First prototype of the Siat 223 all-metal, two-seat trainer built by Siebelwerke-ATG GmbH, a member of the Bölkow Group, is nearing completion here. Aircraft is scheduled to begin flight tests next month, the firm says.

Prototype designs emerged in the summer of a competition sponsored jointly by the West German Minister of Economics and the German Aero Club in 1964, for a standard training and sport flying aircraft.

The Siat 223 is fully aerobatic and suitable for towing gliders with a gross weight of up to 950 lb.

Further development of the aircraft had been suspended since 1961 because of the lack of government funding. Growing interest from West German and foreign buyers, however, has caused the light trainer formerly designated Siefelwerke that it should proceed with development of the prototype, at least with company funds.

A few notes for the Siat 223 has not yet been final, but Siebelwerke says it expects to modify the standard model for approximately \$38,000.

Final decision as to whether the Siat 223's predecessor, the former Siat 222, designed primarily for sport and basic flight (JW Mo. 56, 1958, p. 98), will ever go into production is still pending. Tough competition in the light aircraft field—predominantly from the big three U.S. manufacturers, Beech, Cessna and Piper—may make it difficult

to either justify the original Siat 222 design considerably or song it entirely, a company official said.

Following closely CAR Part 3 specifications, the design of both "normal" and aerobatic flight light aircraft, the Siat 223 is a minimalist low-wing monoplane structure with a fixed

tail. The aircraft is built around a single spar and has a maximum wing chord of 10 ft.

To cut production and maintenance costs as well as hold the factor's manufacturing requirements to a minimum, most of the aircraft's construction parts are interchangeable. The cockpit, for example, can be fitted to form any one of the eleven models. The left and right cockpits can be interchanged.

Siat 223 Specifications

| | |
|-----------------|---------------------------|
| Engine | 110-hp Lycoming O-360 A1A |
| Span | 37.2 ft |
| Length | 21.5 ft |
| Height | 8.5 ft |
| Wing area | 120.9 ft ² |
| Aspect ratio | 9.39 |
| Empty weight | 993 lb |
| Useful load | 703 lb |
| Gross weight | 1,696 lb |
| Min speed | 137 mph |
| Crash speed | 126 mph |
| Landing speed | 75 mph |
| Rate of climb | 16.4 fpm |
| Service ceiling | 18,590 ft |
| Range | 682 mi |
| Wing loading | 13.7 psf |
| Power loading | 11 lb/hp |

on the top seats. The nosewheel and main landing gear units are interchangeable.

Designed as a single-seater aircraft, an earlier Lycoming O-360 A1A engine rated at 150 hp, driving a fixed or retractable variable pitch propeller. When used only for normal training purposes, the aircraft can be fitted with a 135-hp Lycoming O-360-C powerplant.

The Siat 223's rectangular wings have no center spar passing through the fast line.

Fuselage is an all-metal, monocoque structure. Cockpit, with side-boards, is a single unit with dual cable controls plus a sliding seat that allows all-round visibility.

Beech, Piper Report

6-Month Sales Increase

Two major light aircraft manufacturers—Beech and Piper—reported increased sales for the six months ending Mar. 31, and one—Cessna—reported a decrease.

Beech Aircraft Corp. reported sales of \$14,391,112 compared with \$31,809,667 for a corresponding period in 1962. Net earnings were \$1,163,425, down from \$1,145,015 last year at the same time. Sales of the Beech 200—whose design changed from 40 seats to 41 seats per share—was attributed to meeting costs for use production program.

Beech division declared a regular quarterly dividend of 15 cents per share, payable Mar. 1. Of the company's total sales, \$21,164,012 were to commercial customers and \$11,661,033 to the military and aerospace market. Last year, military sales were \$19,563,819 and military and aerospace sales were \$12,475,858.

Cessna Aircraft Co. reported total sales of \$44,317,000 for the six months period ending Mar. 31, compared with \$48,220,000 for the same period in 1962.

Net earnings were \$2,997,000 or \$4 cents per share in 1963, compared with \$1,116,000 or 95 cents per share in 1962. Decline in sales was attributed to a decrease in military business, which dropped more than \$10,000,000 in the year. However, military backlog at of Mar. 31 stood at approximately \$21,930,000, compared with \$15,000,000 at the same time in 1962.

Piper Aircraft Corp. reported sales of \$17,045,459 for the six-month period ending Mar. 31, 1963, compared with \$16,170,306 for same period in 1962. Net income was \$1,000,000, or 61 cents per share, increased 51%, from \$697,315 in 1962 to \$993,165 in 1963. Income per share increased from 6 cents to 93 cents.



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At Lockheed California Company, a team of engineers and scientists currently is engaged in an intensive study of flight and operational characteristics involving America's first Supersonic Commissary Air Transport (SACAT). These studies include evaluation of flight and wind tunnel data to determine performance criteria and mission capabilities of tomorrow's aircraft.

Planned to operate on the fringes of space, SACAT presents many unique problems. The solutions are doubly important, since they involve factors of practical application to various operation. Advanced conceptual studies are also being carried on with VSTOL aircraft, hypersonic fighter aircraft and high-rate helicopters.

Projects such as those at Lockheed-California add up to an exciting future—if you'd like.

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International Atmospheric Study Urged

By Roderick D. Hobson

National Academy of Science is proposing a major international cooperative study of the atmosphere in a world-wide effort to improve the state of atmospheric science.

The study would be an attempt to combine the high level of international cooperation and collaboration achieved during the International Geophysical Year (IGY) and carried through the planning phase of the upcoming International Year of the Quiet Sun (IYQS).

Development of a worldwide system of meteorological services was recommended as the very first goal of the international effort in a report recently released by the Academy's Ad Hoc Committee on International Programs in Atmospheric Sciences and Hydrology under the Geophysical Research Board.

The report spelled out the following technical advances which should be made to facilitate the meteorological system:

- Development of balloons with improved operating characteristics and lifetimes. Major developments could increase balloon operating altitudes up to 100,000 ft, while operating altitudes of 150,000 ft could be expected in the near future.

- Meteorological sounding rocket systems and launching networks which make possible measurements in the area between the operating altitudes of a meteorological balloon and satellite.

- Improved methods of operating a meteorological satellite, including rocket launching with minimum sampling altitudes of 50 m which do not require launching from established missile ranges. Effects also should be made to reduce the cost per sounding rocket launch from \$2,000 to \$100 and rockets should be made of fragile material to eliminate damage over populated areas.

- Improvement of sensing systems which don't require precision radar and high speed computers for data analysis.

- Inclusion of new ozone and radiation monitoring equipment into retrievable systems and development of optical scattering techniques for night observations to obtain temperature, density and atmospheric distribution profiles. The measurement of these profiles, repeated at intervals of 1 sec or longer, appears feasible using pulsed laser angle-sighting systems costing about \$12,000 per unit. Development cost for the entire meteorologic system was estimated at \$200,000.

- Improvement of radar to probe

altitudes 50-85 km high and to record diurnal and seasonal changes in the wind, temperature and density of these stratospheres. Radar systems capable of making these studies would cost about \$50,000 per unit.

Establishment of a meteorological atmospheric network with balloons at enough thousand-meter intervals. Weekly and bi-monthly launch capability would be desirable. Precision and spectrum costs of each meteorological station for two years were estimated at \$140,000. Flight, payload, tracking and telecenter development, using present day markets, would cost \$1 million.

Close cooperation with related geophysical fields, particularly sounding systems, was urged by the Academy's committee since these areas may undergo considerable interaction between the oceans and the atmosphere.

Broad aims of the program will be to cover specific problems of an atmospheric scientist of both practical and scientific importance which would demand greater collaboration between



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Tiros Camera Resolution Shown

Landscape and cloud pattern photograph with the Relia-Cop. of Aerasus which cameras used in Tiros series weather satellites show cameras sensitivity to light-dark contrast. On-base and orbit data is recorded below the photo. From orbit, each camera covers 160,000 sq. mi. Photo is subdivided with overlapping frames for visual governments. The proposal stressed it "offer[s] possible new durable or effective particular research problems that should be attacked by specific groups," however, since traditionally and automatically, governments and scientists, are in their own interests and those of their governments.

Concern for the atmosphere as a natural resource and with the effect of atmospheric processes on human activities was stressed in the report and five broad interdependent groups of atmospheric science activities were proposed. These include:

- Research in weather prediction
- Modification of weather
- Study of the high atmosphere (stratosphere)
- Atmospheric chemistry research
- Increased study of climatology

The basis for meteorological research remains weather forecasting, according to the report, and an atmospheric science program which could explain the weather could profit it.

Only the first \$60,000 of the



JULY 22, 1963

MANNED SPACE FLIGHT ISSUE

- The most important development of this decade, MANNED SPACE FLIGHT, will be the subject of the July 22, 1963 issue of AVIATION WEEK & SPACE TECHNOLOGY. MANNED SPACE FLIGHT, the major segment of the national space program, is planned at \$30 billion for a manned lunar landing. The total space budget requested for fiscal 1964 alone is a record \$7.3 billion.

AVIATION WEEK & SPACE TECHNOLOGY has established an unparaled reputation for detailed coverage of technical and industry developments on the plan, operations, facilities, budgets, organizations and procurement phases of the national space program. Now, a task force of editors will concentrate on both civilian and military manned space projects in an issue devoted entirely to the subject.

Theme of the issue will stress future progress from Project Apollo to manned permanent moon bases, manual orbiting space stations and interplanetary Mars and Venus flights. Editorial highlights will include:

- Major progress report on Project Apollo, its hardware and technical developments
- Status Report on Project Gemini two-man spacecraft including joint NASA-USAF operations.
- What we learned from Project Mercury and how it built a technical foundation for future manned space flight programs
- Technical needs of military in manned space flight, including Dyna-Soar, Aerospace Plane, recoverable re-entry vehicles, interceptor and surveillance satellites
- Russian manned space flight programs and technical progress
- New types of support operations required for large-scale manned flight including simulators, control centers, transport and assembly facilities, tracking and data transmission equipment, medical and life support.

There is no better way to identify your company's role in the space program than by scheduling your advertising in the most important issue of 1963, the July 22nd MANNED SPACE FLIGHT ISSUE. Its timeliness and scope of technical detail will ensure industry-wide attention and study. Wire or call collect for reservations or additional information.

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TESTING ENGINEER—To assist in testing of APOLO Navigation/Guidance, TITAN III & TITAN III Inertial Guidance and B-52 C&D Bombing Navigation System. Will also perform technical research and development of inertial guidance systems for aircraft, missiles and ground vehicles.

WEST COAST—Los Angeles

(Obtained Concepts Laboratory—Research & Development)

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Saturn Forming Process Improved

GM's Mich. and today's process of forming large, 6' diameter, thin-walled plates has been reviewed by Boeing Co., Wash., Inc. By leaving the plates at the same time the material is spot-welded or electrically annealed, normally the 13 x 36-ft. plates would first be formed with press brakes at forming mills and then heat-treated. This requires removing a resultant warp on the part. Continued operation eliminates the warping. Photo shows Boeing technicians mounting plate on a fixture prior to aging-forming process.

requiring over an area slightly more than a hemisphere of the globe.

To correlate with the mathematical model's sampling global meshes a horizontal grid with a spacing of 5 deg. of latitude and a spacing of the grid cells below about 100,000 ft. was fed by the Academy to give adequate coverage of all celestial short-term physical processes. The Academy recommended that placement of observing points in orbits around, measurable lead times, and the types to be given priority.

Radioisotope stations and longduration flights of automated sensing stations by satellite was proposed for these measurable lead times. Fixed or floating beacons could be used in ocean areas. At present, unobstructed balloons with thin-film electronics, capable of lasting, at constant density levels for periods of one

or more months, are the least expensive of all observational methods.

A regional observation program related to the worldwide atmospheric surveillance system, as proposed by the Academy, would study water vapor, temperature, pressure, surface pressure, diurnal, seasonal, monthly, seasonal, and increasing solar radiation in stations of 100,000 ft. in. dia. at 12.24 hr. time intervals.

Water vapor measurements such as air temperature and moisture content, dew point or specific humidity would be needed. The great importance of understanding water vapor transport at extrapolating regional processes into worldwide theories of atmospheric motion should be given prime consideration according to the Academy.

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Compressing Real-Time Human Effectiveness

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An illustration of this dual-folded real-time approach may be found in the Martin Air Command Control System (ACC), for which ITT International Electric Corporation is prime contractor.

Data enters the ACC's network from Earth Communication Centers at over the world. Each FCC site accommodates as many as 1,200 messages per hour by means of up to 28 input/output devices. All messages transmitted within the system are automatically packed, received, and error checked by On-line Error Detection and Correction (OEDAC) Heuristic. Information flows into the Data Processing Center, where a high speed computer compares events reported

by ACC with plans stored in its memory. The DPC will automatically alert the ACC when a very significant deviation between actual and planned events.

At the initial level (SAC), estimation of the initial position of incoming messages by SAC command centers has been greatly enhanced by recent ITT development—data processing software. Optimum real-time approach insures reliable on-line check times less than one display screen. Existing computer capacity to be converted to alphanumeric levels—photographed—developed and projected onto 16 tape control cards in seconds in as many as 7 colors in a matter of seconds.

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from to another by conduction which releases latent heat could be measured by radii. Radiative processes in the atmosphere are also thought to be related to the transfer of energy in water and sand as well as snow. The Andes, says the U.S. regional observation program include stations in the Cordillera and Caribbean.

Weather Modification

Longitude modification of weather could come about through a better understanding of atmospheric response to energy inputs, the committee report concluded. Observations of events such as hurricanes and tropical cyclones in the intertropical region could serve as analogous energy inputs.

The effect of changing the relative characteristics of the upper atmosphere or circulation in the troposphere and of introducing a source of energy in the lower atmosphere, an inobligatory enthalpy, are often important in understanding the atmosphere and the climate. The committee said. Statistical, computational and observational techniques throughout the overall program also were urged.

The high atmosphere studies would involve measurement of the behavior of masses of gases under gravitational, electrical and magnetic forces and bombardment by photon and particle sources, a wide spectrum of energies and intensities. The meteorological studies would be primarily concerned with the 10-30 m. high portion of the



Navy's Patrol Hydrofoil Demonstrated

Navy's first Patrol Craft Hydrofoil (PCH-1, "High Point") demonstrated lift capability of its wholly submerged foil in "Flight Stand" (horizontal) during its speed test in excess of 30 mph. Autonomous controls, used in an arrestor catapult system, keep ship stable at 60 ft. It was said it is intended for use in coastal and intercoastal waters. Prime contractor to the Navy hydrofoil is the Boeing Co.

AVIATION WEEK & SPACE TECHNOLOGY, June 12, 1983



Management

Climate research would involve studying past, present and future climates with efforts toward exploring the possibilities and consequences of wind and flooding patterns throughout the world. Included would be studies on early reactions to long-distance solar activity. Measurements, a new discipline, would also be planned between meteorology and astrophysics, and would study the great changes being made by man on his own environment, both in the significant population growth that has occurred during this century.

Strengthening the overall Academy program would be a meteorological service organization to disseminate the results of the work being done and to define the relation between science and research facilities among academic and industrial institutions.

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FINANCIAL BRIEFS

Northrop Corp. sales for the most recently ended Apr. 25 totalled \$257.9 million, with a net income of \$6 million—\$1.45 per share. Comparable figures for last year showed sales of \$245.3 million, with earnings of \$6.1 million—\$1.51 per share. Apr. 25 order backlog stood at \$325 million compared with \$310 million a year earlier.

Firefield Systems Corp. reported a net loss of \$1.7 million on sales of \$11.3 million for the first quarter of 1965. First quarter 1962 showed earnings of \$160,000 on sales of \$27.3 million. Losses were attributed to delays in completion of some programs and starting costs of newer ones. Also, a decision was made to write off an acquired license on contracts where cost overruns are anticipated.

Aerospace Market & Finance Co. had a net income of \$5.4 million on sales and earnings totaling \$69.4 million for the first quarter of 1965. Comparable figures for last year showed a net income of \$7.9 million on sales and earnings of \$125.9 million.

Westinghouse Electric Corp. earned \$12.6 million on sales of \$469.7 million for the first quarter of 1965. Sales were below the first quarter of 1964's \$11.8 million on sales of \$460.5 million. First quarter earnings were 24 cents per share this year and 32 cents last year.

Rolls-Royce, Ltd. reported 1965 profits equal to \$4.5 million on sales of \$300.5 million. Figures for 1963 showed profits of 57 million on sales of \$143.2 million.

Lockheed Corp. reported a net income of \$10.6 million—\$1.36 per share—on sales of \$426.2 million for the first quarter of 1965. Comparable figures for last year showed a net income of \$7.8 million—\$1 per share—on sales of \$393 million. Aircraft unit accounted for \$203 million in sales, missile and space work for \$204.9 million, and shipbuilding, electronics and propulsion for \$2.2 million.

Thompson Radio Worldwide, Inc. had sales of \$117.4 million, with a net income of \$1 million—\$0.10 per share—for the first quarter of 1965. First quarter 1962 showed sales of \$111.7 million and a net income of \$2.9 million, equal to 75 cents per share.

Grumman Aircraft Engineering Corp. reported \$1.9 million earned on sales



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of \$106.7 million for the first quarter of 1963. Compagnie 1962 figures showed \$2 million more in sales of \$44.9 million. Earnings per share were 60 cents per share and 94 cents per share for the 1961 and 1962 fiscal years, respectively. Order backlog stood at \$76 million on Mar. 31, compared with \$39 million on Mar. 31, 1962.

International Telephone and Telegraph Corp. had earnings of \$8.4 million, up 25% to 56 cents per share—on sales and revenue of \$279.9 million for the first quarter of 1963. Compagnie figures for last year showed \$8.2 million earnings—49 cents per share—on sales and revenues which totaled \$242 million.

Atavion Corp. reported \$1.2 million—55 cents per share—on sales of \$10.5 million, up 25% to half of its fiscal year ended Mar. 31. Comparable figures for last year showed \$1.6 million—\$1.22 per share—on sales of \$17.8 million in sales.

United Aircraft Corp. reported a net income of \$17.7 million on sales and other revenue of \$279.9 million for the first quarter of 1963. First quarter 1962 totals showed a net income of \$4.6 million on sales of \$277.6 million. Commercial sales were down \$1.6 million but were offset by increased billings from development and prototype contracts. Government sales showed little change. Order backlog stood at \$1 billion on Mar. 31, compared with \$1.04 billion a year before.

B.F. Goodrich Co. reported 1963 sales above the \$512 million peak reached in 1962 and profits higher than the \$53.3 million earned that year. President J. W. Keeler told stockholders that declining product prices, which have cut the company's \$108 million per year, have stabilized and cost reduction programs are saving about \$25 million annually.

Thermal Chemical Corp. reported earnings of \$1.5 million, equal to 18 cents per share, on sales of \$63.8 million for the first quarter of 1963. Some profit last year showed earnings of slightly more than \$1.4 million, equal to 18 cents per share, on sales of \$61.5 million.

Along Servotronics, Inc., earned \$342.312 on sales of \$13.4 million for the nine-month period ended Mar. 31. Comparable period ended Mar. 31, 1962, showed earnings of \$275.982 on sales of \$10.2 million. Pro forma earnings for the 1961 and 1962 periods were 69 cents and 55 cents, respectively.

Immediate Boeing openings on

SATURN

The Saturn V will be the first world's largest rocket and one of the first developed specifically for scientific space programs. Boeing has primary developmental, building and test responsibility for the Saturn V first stage booster. This uniquely challenging program

offers outstanding long-range career opportunities, listed on the following page, for engineers and scientists. We suggest that you fill in the professional application form which begins below and continue on the following page.

MAIL FORM TODAY

PROFESSIONAL POSITION APPLICATION (All replies held in strict confidence)

Date of this Application _____

Name _____
Social Security No. _____

Present Address _____
City _____ State _____ Zip _____

Telephone No. _____

Date of Birth _____ US Citizen _____

Male _____ Female _____ Marital Status _____

No. of Children _____ Other Dependents _____

US Military Service: Yes No

Branch Service _____

Type of Discharge _____

Fall Name of Sponsor _____

Present Boeing Employee? _____

If the answer to following two questions is "yes," explain in supplementary sheet.

1) Have you any physical defects? _____

2) Have you ever been arrested (except minor traffic)? _____

HIGHER EDUCATION

| College and University | State Attended | Major and Minor |
|------------------------|----------------|-----------------|
| | | |
| | | |



The large Saturn V will stand about 350 feet high and measure 33 feet in diameter. Its total weight is estimated at approximately six million pounds. The Boeing first-stage booster, powered by a cluster of five engines, will have a total thrust of 7.5 million pounds.

Boeing's Saturn Booster Branch has a number of long-term openings offering exceptional growth and opportunities. Immediate assignments are available to engineers in the following fields of interest:

- electrical/electronic
- structural design
- aerodynamics
- propulsion
- systems test
- mechanical design
- industrial
- manufacturing
- facilities
- high vacuum
- cryogenics
- dynamics
- instrumentation

Assignments will be in New Orleans or Huntsville, Alabama. Other Saturn operations – as well as assignments on such additional Boeing missile and space programs as the Minuteman ICBM and the Dyna-Soar boost glide vehicle – are available at Seattle, Cape Canaveral and Vandenberg AFB. Boeing pays travel and sprung allowances to newly-hired personnel.

You'll find space in the application below to indicate your specific interests. Fill in and mail today.

BOEING

AEROSPACE DIVISION

Other Divisions:
Airplane • Vertol • Industrial Products
Also, Boeing Scientific Research Laboratories

FORM BEGINS ON PREVIOUS PAGE

EMPLOYMENT HISTORY (check boxes)

| | | |
|------------------------|--|-----------------------------------|
| First place of address | Non-Pvt Offic. or Mkt. Rep. or Exec. | Employed/Unemployed Month/Year |
| 1 | _____ | _____ |
| 2 | _____ | _____ |
| 3 | _____ | _____ |
| 4 | _____ | _____ |
| 5 | _____ | _____ |
| 6 | _____ | _____ |
| 7 | _____ | _____ |

LIST TYPE OF WORK PREFERRED UPON
EMPLOYMENT:

Have you ever been cleared for classified military defense work? _____ If yes, give date, level and company.

May we contact your former and present employer prior to completion of employment negotiations? Yes _____ No _____ If "yes," list former, without liability, the names of all employers and personnel interviewed.

NON-PRIOR WORK HISTORY

The Boeing Company is an equal opportunity employer

RETURN TO: MR. L. W. HAYS, THE BOEING CO.
P.O. Box 26888-AWY, New Orleans, Louisiana

REFERENCES: Give full names, occupations and addresses
of references (previous supervisor preferred):

1 _____

2 _____

Character (other than relatives or former employer):

CAN YOU BRING
NEW INSIGHT
TO
**ADVANCED AEROSPACE
SYSTEMS PROBLEMS**
?

Bell Aerosystems, long recognized for outstanding advances in the aircraft and aerospace industry, has again succeeded in obtaining contracts requiring Engineers who are able to apply their great experience to the ever new challenges of space.

PRESENT PROGRAMS INCLUDE:

VTOL AIRCRAFT

• A leader in a series of vehicles that will effectively demonstrate on earth, the unique problems and classic aerospace problems of vertical landing. It will utilize a jet engine to take off vertically and land vertically at approximately 2,000 feet. The jet engine will be developed here to provide 50% for only 5% the vehicle weight, the compressor will be supported by 2 hydrogen, porous, regenerators. Bell Aerosystems Co. has been selected to design, develop and manufacture this vehicle.

GEN VEHICLE

Recently a contract was awarded to Bell by Bellings to design and build a high performance vehicle, the SRM-1. SRM-1 is a 3000lb. 80 foot long and weighs 10 tons. It will be required to penetrate over a foot of concrete at a velocity of 50 miles per hour. This is the largest GEN program in the U.S. today.

CT-41

A small, high performance maneuverable vertical missile will be tested and produced in the United States under license from Nord Aviation of France.

OPPORTUNITIES ARE OPEN FOR:

- Aerodynamicists
- Propulsion system performance analysis and related research analyses.
- Wind tunnel test and propulsion system tests for determining aerodynamic characteristics including the determination of control and test equipment required in support of such research tests.

Qualifications determine level of assignment – BS or MS degree required plus 2-10 years related experience. Military communications with experience.

To continue our increasing trend in space development, opportunities also exist for:

**SPACE SYSTEMS DEVELOPMENT
ENGINEERS**

Technical Directors and Project Engineers required for the preliminary design of space vehicles and space powerplants systems. Detailed requirements and opportunities available at the headquarters of larger programmatic organizations of the aerospace industry. BS or MS degree and 5-10 years experience with advanced degree preferred, and 5 to 15 years experience in system engineering. Salary \$11,000 to \$16,000.

OTHER IN-HOUSE CONTRACTS INCLUDE:

• Defense contracts for subsystems, parts in the aircraft industry, and other contracts for the development of aircraft components and subsystems. Bell Aerosystems Co. has been selected to design, develop and manufacture this vehicle.

• MILITARY ENGINEERS • VALUE ENGINEERS • STRUCTURES ENGINEERS • WEARIES ENGINEERS • ROCKET MECHANICAL ENGINEERS



Resumes desired. Please write Mr. Thomas Friend, Dept. S-25.

BELL AEROSYSTEMS CO.

DIVISION OF BELL AEROSPACE CORPORATION - A  COMPANY

An Equal Opportunity Employer

P.O. Box #1, Bellfiled 5, New York

aerospace engineering ... at AVCO/RAD



Some of the most difficult work in solving re-entry problems, Avco/RAD has done. It's work that requires a high level of technical skills and a broad knowledge of aerospace and missile requirements. Avco is a leader in aerospace and provides opportunity to participate in a number of basic and new projects which demand creativity and stimulate your professional growth.

Avco/RAD also has all logic engineering facilities and their latest refinements in such programs as APOLLO/TITAN, MINUTEMAN, MIG-3330 and other classified projects.

Openings Exist in the Following Areas:

ELECTRONICS/ ELECTROMECHANICS

- Design & Development
- Space Telemetry & Communications
- Solid State Circuits
- Active & Components
- VHF & Microwave Solid State
- Antennas & Waveguides
- Solid State Power Sources
- Solid State Fueling Systems
- Electrical Ground Support Equipment
- Service Hardware Electronics
- Space Power Sources
- Analog/Digital Circuits
- Electromagnetic Resonating Theory
- Plasma Analysis
- Advanced Manufacturing Techniques
- Information Theory
- Nuclear Radiation Effects

STRUCTURES

- Structural Design Methods
- Structural Loads
- Structural Analysis
- Dynamic Analysis
- Structural Testing
- Structural Mechanics

The Division's facilities are located in Wilmington, Lowell and Lawrence, just south of metropolitan Boston. At Avco/RAD you can share in leading universities, cultural events and excellent recreational facilities.

Send resume to
Mr. J. Bergin,
Dept GFA

Avco
Research & Advanced Development

A Division of Avco Corporation
201 Lowell St., Wilmington, Mass.

An equal opportunity employer

SPACE FLIGHT-TEST TECHNOLOGY

- Thermodynamics
- Aerodynamics
- Systems Dynamics
- Trajectory Analysis
- Test-Setup Technology

SYSTEMS ANALYSIS

- Systems Optimization
- Trade-Off Definition
- Operations Research
- Game Theory
- Measurement Systems

RELIABILITY ANALYSIS & ENGINEERING

- Reliability Analysis
- Statistical Test Design & Analysis
- System Evaluations
- Design Services
- Engineering Test Planning & Evaluation
- Failure Analysis

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INTERESTING OPPORTUNITY AVAILABLE

Avco Electronics Division has an immediate opening for a Systems Analyst in the Research & Development Department. The position requires a Bachelor's degree in Electrical Engineering and a minimum of 5 years experience in the design of electronic systems. Experience in the design of solid state electronic systems is required.

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LETTERS

TFX Comment

Your coverage of the TFX seems interesting and, not just for the money on the May 17 ad, deserves high praise.

There is nothing mysterious in the world of contracts in politics or commerce. It is a simple matter of money and time. It has been spent in the effort to camouflage this one. But whatever the reason, the operational date of the F-111 has been at least nearly two years. This date is in the public domain. It cannot be the choice of someone who questions whether the aircraft will represent a sufficient advance over a growth version of the F-4 (with TFE30 instead of the jet engine but record beat in 1972/1973).

A paper delivered to the Society of Automotive Engineers in April of 1971 (SAE 71011) the current write pointed out that no new breakthroughs are required to increase combat performance if this can be achieved the way to a revolution in flight gear that was that has just been. The paper also says that wings can be folded, and the cost for wings and engines will probably be lower. The aircraft will then be free from the cost of having to fit extreme altitude in order to never conceivable range. It was good to note that flat-faced Lockheed made the same point in their report to the Air Force (AFW 72-37, p. 33), where he predicted the appearance of a wingspan for commercial use within ten years.

The Congress apparently understood this so we force them in considering an article about the TFX. So in next passage from the fight, the aircraft will be shown to not fly. We will be able to update this flat-faced looks.

Not so the F-111, which will and may well at least half a mile long and even in where the performance will be better than all the others. That looks like it is to make in the Senate hearing, unavoidable, wings, their revenue at levels, exceeding growth overgrowth structure.



"LET'S NOT CLASSIFY THIS SECRET"
"IT'S STILL BE HUGHES!"

Admiral Flook addresses the problems of the record beat. He is not the only one to do this. The *Washington Post* (May 17, 1973, p. 1) and *Newsweek* (May 14, 1973, p. 26) also do this. The *Washington Post* (May 17, 1973, p. 1) and *Newsweek* (May 14, 1973, p. 26) also do this.

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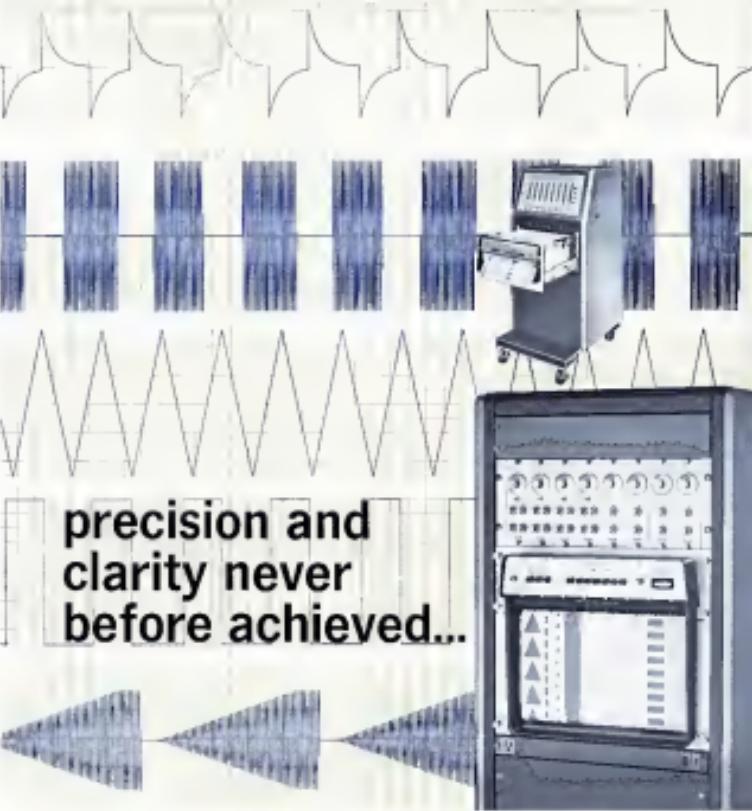
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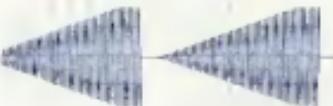
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JUN. 20 1963

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